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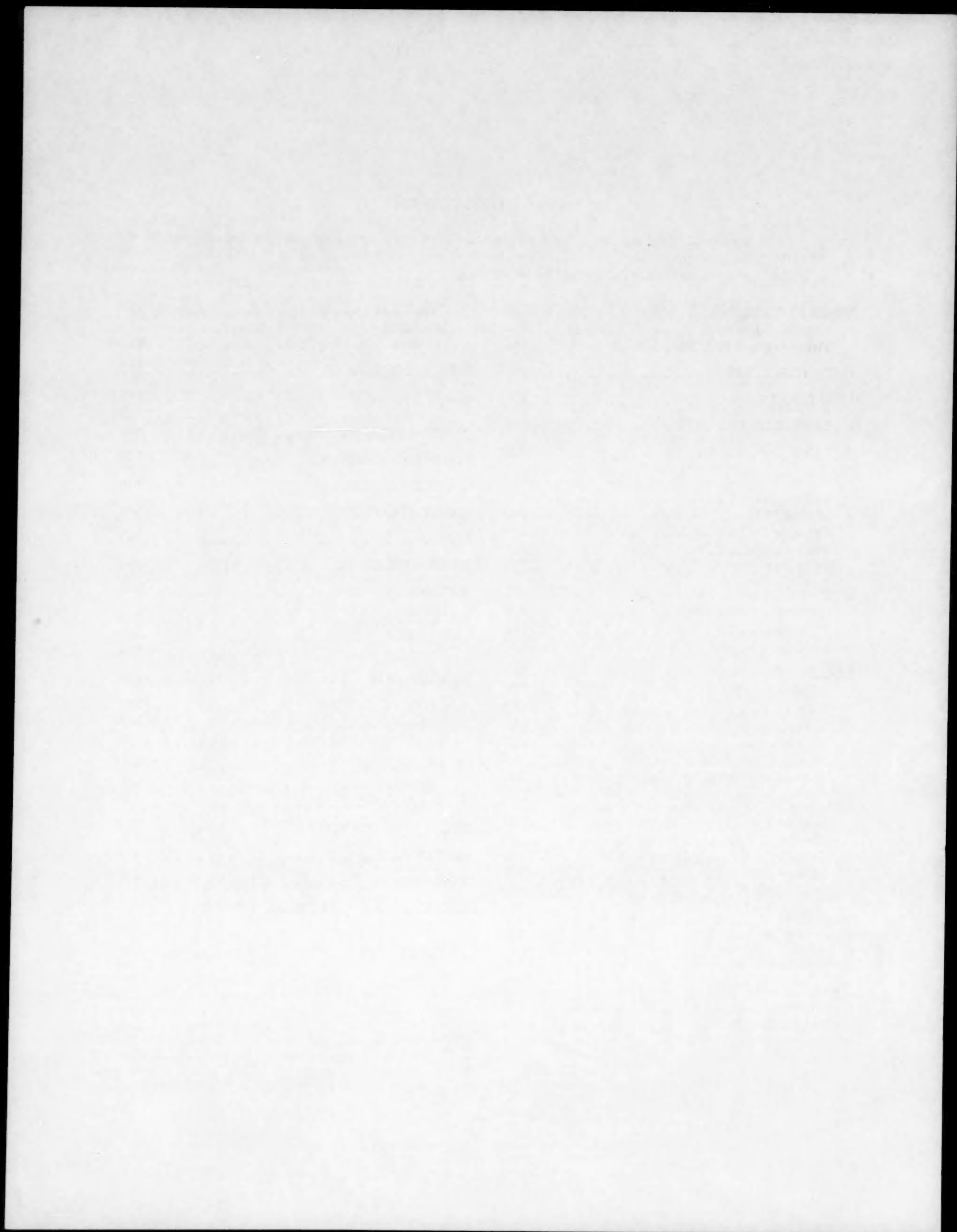
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AGRICULTURE

AGRICULTURE, GENERAL

SOLS BRUNS ACIDES IN THE NORTHEASTERN UNITED STATES. GENESIS, MORPHOLOGY, AND RELATIONSHIPS TO ASSOCIATED SOILS.

(L. C. Card No. Mic 60-2492)

Klaus Werner Flach, Ph.D.
Cornell University, 1960

Sols Bruns Acides are thin acid soils with weak horizon differentiation. A thin A₁ horizon is underlain by a brownish B horizon with weak subangular blocky structure. The solum may be finer textured than the parent material, but there is little or no textural differentiation within the solum.

Relationships between Sols Bruns Acides and associated soils were studied along two geographic transects involving variations in the soil forming factors climate, vegetation and time. The factors parent material and topography were held constant as far as possible. One transect on Wisconsin-age granitic glacial till extended from a cool climate and a presettlement coniferous vegetation in New Hampshire (Podzols and Brown Podzolic soils) to a warmer climate and deciduous vegetation in southeastern New York and northern New Jersey (Sols Bruns Acides). These soils were compared to Red-Yellow Podzolic soils on pre-Wisconsin glacial till in an environment identical to that of the Sols Bruns Acides.

Degree of weathering, estimated by degree of textural differentiation, weathering of primary minerals and changes in the composition of the clay fraction, differed only slightly among Podzol, Brown Podzolic soil and Sol Brun Acide. Among primary minerals only biotite was significantly weathered, and among clay minerals illite had partly weathered to vermiculite but significant amounts of kaolinite were not detected. In the Red-Yellow Podzolic soil, biotite, hornblende and feldspars were strongly weathered, and kaolinite was a significant component of the clay fraction.

Distinctly different processes of soil formation could be inferred in each of the Great Soil Groups studied, as based on particle size distribution and properties of organic matter as well as free iron-total iron and free iron-clay relationships. Soil forming processes in Podzols and in Brown Podzolic soils were inferred to be similar and to be greatly different from those in Sols Bruns Acides and in Red-Yellow Podzolic soils. Such conclusions were supported by thin-section studies.

Similar relationships were found in a second transect involving Brown Podzolic soils, Sols Bruns Acides and Red-Yellow Podzolic soils developed on glacial till from sedimentary rocks of south central New York and north central Pennsylvania. These soils, however, were studied in less detail than those of the first transect.

Podzols and Brown Podzolic soils have similar microstructures, lack a close free iron-clay relationship and

contain organic matter that is highly soluble in sodium pyrophosphate. Sols Bruns Acides and Red-Yellow Podzolic soils exhibit similarities in microstructure, have a high correlation between free iron and clay and contain organic matter of relatively low solubility in sodium pyrophosphate. On the basis of such criteria, Brown Podzolic soils may be differentiated from the morphologically similar Sols Bruns Acides. The distribution of free iron in the profile, without the consideration of clay distribution, and the C-N ratios of the organic matter cannot be used to differentiate soils of the two Great Soil Groups.

It is postulated that Sols Bruns Acides are intermediate members of a time sequence that progresses from Regosols to Sols Bruns Acides to Red-Yellow Podzolic soils. Brown Podzolic soils and Podzols may be members of a different pedogenic sequence.

The color of the B horizon of Sols Bruns Acides may be attributed to hydrated iron oxide coatings on clay particles. The weak subangular blocky structure of the B horizon is due to parallel alignment of clay particles in the ped peripheries.

Intergrades from Red-Yellow Podzolic soils and Regosols to Sols Bruns Acides may be mono-sequence profiles while intergrades from Gray-Brown Podzolic soils and Brown Podzolic soils are thought to be bi-sequence profiles. Microfilm \$2.85; Xerox \$9.90. 218 pages.

AGRICULTURE, ANIMAL CULTURE

THE EFFECT OF NO FERTILIZATION AND NON-NITROGENOUS FERTILIZATION UPON THE CHEMISTRY OF WATER, THE PLANKTON, BOTTOM ORGANISM AND FISH PRODUCTION IN PONDS THAT HAD RECEIVED COMPLETE (N-P-K) FERTILIZERS FOR THE PRECEDING 15-YEAR PERIOD.

(L. C. Card No. Mic 60-2647)

Herminio Ranit Rabanal, Ph.D.
Auburn University, 1960

Supervisor: Homer S. Swingle

Two species of fish, common carp and goldfish, were used to test the effect of no fertilization (0-0-0), non-nitrogenous fertilization (0-8-2), and complete fertilization (8-8-2, N-P₂O₅-K₂O) in ponds that had received continued application of complete fertilizers during the preceding 15-year period. Complete fertilization (8-8-2) resulted in an average production of 348.8 pounds of carp and 700.6 pounds of goldfish per acre. No fertilization (0-0-0) produced an average of 275.2 pounds of carp and 422.6 pounds

of goldfish per acre, or 73.6 pounds less for carp and 278.0 pounds less for goldfish than complete fertilization. These differences were significant with goldfish but not with carp. Ponds with non-nitrogenous fertilization (0-8-2) produced an average of 312.4 pounds of carp and 616.2 pounds of goldfish per acre, or 36.4 pounds less for carp and 84.4 pounds less for goldfish than in the ponds with complete fertilization. Although the 8-8-2 had consistently higher average production than the 0-8-2 ponds, the differences did not reach a level of significance.

The effects of complete fertilization during the preceding 15-year period in ponds that were unfertilized in the present experiment were estimated to have increased carp production 3.7 times and goldfish production 1.7 times that obtained in their original unfertilized state.

The amounts of aquatic insects and plankton in the fertilized 8-8-2 and 0-8-2 ponds were significantly higher than in the unfertilized (0-0-0) ponds. The averages per sampling period of these organisms (insects and plankton) were consistently higher in the 8-8-2 than in the 0-8-2 ponds, but the differences were not statistically significant.

The concentrations of total nitrogen dissolved and in suspension in the water were significantly different among treatments; highest in the completely fertilized ponds, next highest in the phosphate-potash fertilized ponds, and lowest in the unfertilized ponds. The total nitrogen content of the unfertilized pond waters remained at about the same level throughout the experimental period; that of the 0-8-2 ponds gradually increased; and that in the 8-8-2 ponds increased at an even higher rate.

Organic nitrogen followed a trend parallel to that of the total nitrogen in the pond waters. Inorganic nitrogen (ammonia plus nitrate) gradually decreased during the experimental period. Ammonia which was more abundant than nitrate declined rapidly while nitrate increased slightly. Carp ponds had significantly lower levels of ammonia but higher levels of nitrate than goldfish ponds receiving similar treatments.

The concentrations of dissolved inorganic phosphorus were significantly higher in the 8-8-2 and 0-8-2 ponds than in the 0-0-0 ponds. Phosphorus after its application disappeared from solution at the calculated rate of 12.7 and 14.3 per cent per day in the 0-8-2 and 8-8-2 ponds respectively.

The biological data indicated that discontinuance of fertilization limited fish, aquatic insect, and plankton production. The chemical data tended to suggest that indigenous pond sources played the major role in supplying nitrogen in ponds previously fertilized for a 15-year period and used for fish cultural purposes; the magnitude of elemental nitrogen fixation was not measured.

Microfilm \$2.50; Xerox \$5.40. 109 pages.

UNIDENTIFIED GROWTH FACTOR(S) IN SOYBEAN OIL MEAL

(L. C. Card No. Mic 60-2593)

Robert Alvin Wilcox, Ph.D.
South Dakota State College, 1960

Supervisor: Professor Charles Wendell Carlson

A large difference in rate of growth was observed between poultts receiving protein from isolated soybean protein and poultts receiving protein from soybean oil meal. Water extraction of the soybean oil meal at the isoelectric point (pH 4.7) was found to remove material which would increase the rate of growth of poultts on an isolated soybean protein diet. The growth promoting factor(s) was not extracted from the soybean oil meal by 100 percent acetone or by 100 percent ethyl alcohol.

The water extract appeared to have both organic and inorganic growth promoting components. Aqueous solutions of ethyl alcohol appeared to dissolve a portion of the factor(s) from the dried water extract. High concentrations of ethyl alcohol and acid (pH 1) or alkaline (pH 10) conditions did not appear to impair the growth promoting activity.

A possible interaction between corn oil and the growth promoting activity of water extract was indicated. Thiocetic acid was without effect on poult growth.

Microfilm \$2.50; Xerox \$4.20. 80 pages.

AGRICULTURE, FORESTRY AND WILDLIFE

RELATIONSHIPS BETWEEN VARIOUS MEASURABLE STAND FACTORS AND VARIATION IN BASAL AREA IN LONGLEAF-SLASH PINE FLATWOODS FORESTS OF ALACHUA COUNTY, FLORIDA.

(L. C. Card No. Mic 60-2576)

Kenneth Roberts Swinford, Ph.D.
University of Michigan, 1960

A study was made to determine the nature and extent of timber stand variability as related to measurable stand factors observed in the longleaf-slash pine flatwoods forests of northeastern Alachua County, Florida.

Data were obtained by representative random sampling procedures from 41 separate stands in random locations in the vicinity of Waldo, Florida. Sampling percentage of 22.2 per cent was constant for all stands. Basic computations and the correlations between the dependent variable and the independent variables were calculated on electro-mechanical computing equipment (primarily the IBM 650). Variables found to be significantly correlated with the dependent variable (coefficient of variation in basal area per plot) were: average basal area per acre, average number of trees per acre, coefficient of variation in number of trees per plot, crown closure per cent (measured from individual plots on vertical aerial photographs), coefficient of variation in crown closure per cent, and per cent of

total diameter classes having ten per cent or more of the total number of trees.

Equations and tables for the prediction of the dependent variable on the basis of the observed significant single and multiple correlations were developed, and their application in the determination of the number of sample

plots for required accuracies in timber cruising is illustrated.

Findings of the study demonstrate the feasibility of the suggested approach for obtaining an objective estimate of stand variability in advance of a timber cruise.

Microfilm \$2.50; Xerox \$6.80. 143 pages.

ANTHROPOLOGY

EXCAVATION AND INTERPRETATION OF
EARLY PUEBLOAN OCCUPATIONS AT
TESUQUE BY-PASS SITE AND IN THE
UPPER RIO GRANDE VALLEY

(L. C. Card No. Mic 60-2550)

Charles Harrison McNutt, Ph.D.
University of Michigan, 1960

During the summer of 1955, the writer supervised archaeological excavations at the Tesuque By-Pass Site, located approximately six miles north of Santa Fe, New Mexico. This project was a part of the New Mexico Highway Salvage Archaeology Program.

The problems arising from these excavations and treated in this study are: (1) to describe the material recovered, (2) to analyze evidences of human occupancy at the site, (3) to compare this evidence with that from other occupations in the area, (4) to formulate the interpretation of prehistoric occupations in the area that is in closest accord with available information, and (5) to isolate pertinent subjects for future research.

In Part I of the study, evidences of human occupancy at the site are described and analyzed. Although the site is small, three distinct occupations, or cultural components, were found. The components represent sequential stages of the early Pueblo culture of the upper Rio Grande Valley. Also, two early pit-houses were discovered which could neither be assigned to nor distinguished from the earliest cultural component at the site. Chronological limits for each component and occupation are estimated, on the basis of ceramic associations, as:

Santa Fe Component	1200-1300 A.D.
Kwahe'e Component	1100-1200 A.D.
Red Mesa Component	950-1100 A.D.
Pit-house Occupation, Area B	900-1100 A.D.
Pit-house Occupation, Intermediate Area	900-1100 A.D.

In Part II of the study, the cultural components of Tesuque By-Pass Site are compared with similar occupations in the upper Rio Grande Valley. Dissimilar cultural manifestations in this same area are discussed and, finally, occupations in areas beyond the upper Rio Grande Valley that are comparable to those at Tesuque By-Pass Site are outlined.

It was found that the Red Mesa, Kwahe'e, and Santa Fe Components of Tesuque By-Pass are characteristic of early Anasazi Pueblo occupations in the upper Rio Grande Valley between the present-day towns of Santa Fe in the south and Espanola in the north. Similar occupations also occur east of the Sangre de Cristo Mountains, on the headwaters of western tributaries of the Canadian River. The portion of the Rio Grande Valley occupied by these Pueblo groups increased with the passage of time.

Dissimilar but contemporaneous cultural components in the Rio Grande Valley south of Santa Fe are basically Anasazi and are ancestral to the Red Mesa Component at Tesuque By-Pass Site.

Occupations comparable to, but slightly earlier than, those found at Tesuque By-Pass Site are reported from the Chaco-San Juan region of northwestern New Mexico and southwestern Colorado. Diffusion of many cultural traits from the northern Chaco-San Juan is apparent, and it is postulated that this diffusion was accomplished in part by emigration of small social groups from the Chaco-San Juan. These groups apparently moved southeastward down the valley of the East Puerco River, eastward below the Jemez Mountains into the Rio Grande Valley, and, finally, northward into the Santa Fe-Tesuque area. The earliest Anasazi groups probably reached the Rio Grande Valley by 750-800 A.D., and were the first agriculturalists and pottery manufacturers to settle the upper Rio Grande area. They did not penetrate the region north of Santa Fe to any degree until after 850-900 A.D.

In Part III, the conclusions of this study are summarized, and an interpretation of Puebloan occupancy of the upper Rio Grande Valley during the period 750-1300 A.D. is presented. In closing, several areas of research pertinent to a better understanding of this period are discussed. Microfilm \$3.55; Xerox \$12.40. 274 pages.

ASTRONOMY

CURVE OF GROWTH OF C₂ ABSORPTION BANDS APPLIED TO THE PROBLEM OF THE C¹²/C¹³ ABUNDANCE RATIO

(L. C. Card No. Mic 60-2517)

John Leroy Climenhaga, Ph.D.
University of Michigan, 1960

A spectrographic investigation is made in the region of the 1,0 C₂ Swan bands of a number of R- and N-type stars. The purpose is to determine the abundance ratio C¹²/C¹³ when curve-of-growth effects are taken into account. These effects were neglected in the previous determinations by McKellar and by Wyller.

The observations include 42 single-prism Victoria spectrograms (with dispersions of either 69 Å/mm or 41 Å/mm at +4740) of eight R-type stars showing C¹²/C¹³ bands. In addition, intensity tracings were available of ten high-dispersion spectra obtained at Mt. Wilson, Palomar and Victoria. The dispersions ranged from 4.6 Å/mm to 14.4 Å/mm. Five of these ten spectrograms are of two R-type stars showing C¹²C¹³ bands, three are of two R-type stars not showing C¹²C¹³ bands, and two are of two N-type stars.

Nineteen of the single-prism spectrograms are of the unique R-type cepheid variable RU Camelopardalis. They were used to test the extent of curve-of-growth effects. The carbon bands vary from weak to moderate at different phases. The C¹²/C¹³ abundance ratio was determined neglecting curve-of-growth effects and was plotted against total band intensity. The resulting points showed a small but appreciable slope, indicating the existence of a correspondingly appreciable curve-of-growth effect.

The Minnaert semi-empirical equation $1/R_\lambda = 1/R_c +$

$1/\zeta_\lambda$ was used to compute profiles for the head-forming regions of the $\lambda 4737$ C¹²C¹² and $\lambda 4745$ C¹²C¹³ Swan bands for different numbers of absorbing molecules, first assuming no C¹³ is present and secondly, assuming for the abundance ratio C¹²/C¹³ the three values 100, 20, and 4. High-dispersion spectra of two carbon stars showing no bands involving C¹³ were used in choosing the values for the damping constant $\mathcal{A}(0.10)$, and the Doppler line width $\Delta\lambda_0(0.15 \text{ Å})$, involved in the optical depth τ_λ in the Minnaert equation. R_c was taken as 0.90. There is good general agreement between computed and observed band profiles. From the computed profiles curves of growth were constructed for the head-forming region of the C¹²C¹² band. Equivalent widths of bands in stellar spectra all fall beyond the linear part of the curve of growth.

The curve of growth was used with the observations to obtain abundance ratios. From the single-prism Victoria plates the mean value of C¹²/C¹³ was found to be 5.8. From the high dispersion spectra of the two R-type stars showing C¹²C¹³ bands the mean value was found to be 4.7. These figures indicate that McKellar's mean of about 3.5 should be increased by about 50 percent owing to curve-of-growth effects. Also, these higher values are in better agreement with the value of 4.6 determined from nuclear theory to represent the equilibrium ratio of C¹²/C¹³ when the CN cycle is in operation. Abundance ratios (C¹²/C¹³) of 8.1 and 16.1 were found for the two N-type stars. For the two R-type stars showing no certain evidence of C¹³, the abundance ratio was estimated as ≥ 100 .

The thesis presents several suggestions for future programs of observation and calculation relative to the subject of the carbon isotopic abundances in stellar atmospheres. Microfilm \$2.50; Xerox \$4.80. 93 pages.

BACTERIOLOGY

COMPARATIVE VIRULENCE STUDIES OF STAPHYLOCOCCI

(L. C. Card No. Mic 60-2631)

Samih Youssef Alami, Ph.D.
The University of Oklahoma, 1960

Major Professor: Dr. F. C. Kelly

A soft agar technique which is efficient in the simultaneous demonstration of the coagulase and clumping factor activities of staphylococci is described. This technique reveals rare strains of staphylococci which are positive for one of these properties exclusively and it facilitates isolation of such variants from mixed staphylococcal populations.

Thirteen strains representing typical coagulase-positive and coagulase-negative staphylococci and staphylococcal variants with unusual combinations of coagulase and clumping factor activities were selected for virulence studies. The LD₅₀ and ID₅₀ values of each strain were determined by injecting challenge doses of washed cells into mice intravenously and intraperitoneally.

Regardless of their coagulase activity, clumping factor-negative strains of staphylococci were more virulent, as judged by LD₅₀ values, when injected intraperitoneally than when introduced by the intravenous route. Conversely, staphylococci which possess the clumping factor, irrespective of coagulase activity, appeared to be more virulent by the intravenous route. The most virulent of all strains tested by the intraperitoneal injection of mice were the coagulase-positive, clumping factor-negative strains.

In the experimental infections, the degree of kidney involvement appeared to determine whether or not the animal survived. A strain which showed remarkable predilection for skeletal muscles, rather than the usual tendency of staphylococci to localize in kidney tissues, was less virulent than other strains with similar coagulase and clumping factor activities.

ID₅₀ values indicate that infection was established more readily when staphylococci were introduced by the intravenous rather than by the intraperitoneal route.

The least virulent of the staphylococci tested disappeared from the tissues by the second to the fourth post-infection week, whereas the more virulent staphylococci persisted, mainly in the renal tissues, for as long as 6 to 8 weeks.

Certain variations in the *in vitro* properties of the selected strains were observed. Noteworthy among these was a mucoid variant which was recovered from the infected mice. The cells of this variant were enveloped in a demonstrable slime layer. The mouse virulence of the mucoid strain was less than that of the coagulase-positive, clumping factor-negative parental type.

From the evidence of these studies it is not possible to assign staphylococcal virulence to any particular *in vitro* property of the organisms. The coagulase-positive strains were more virulent than the coagulase-negative strains. However, in certain instances, coagulase production could not explain the degree of virulence.

Lack of an undefined cell surface component or activity, known variously as bound coagulase, clumping factor or, in terms of the soft agar technique, colony compacting factor, was a common property of the rare strains of staphylococci which have unusually high virulence for mice when injected by the intraperitoneal route.

Microfilm \$2.50; Xerox \$7.60. 162 pages.

POLYSACCHARIDES PRODUCED BY SOME WOOD ROTTING FUNGI

(L. C. Card No. Mic 60-2612)

Francis Henry Milazzo, Ph.D.
Syracuse University, 1960

The purpose of this work was to obtain and qualitatively characterize polysaccharide material produced by some wood rot fungi (Basidiomycetes) in a chemically defined medium. This material was synthesized in such a medium, when a combination of high carbohydrate (10%), low nitrogen (0.012%) and low phosphate (0.006%) were supplied to the organisms. Shake culture, followed by still culture, were requisite for this synthesis.

Three carbon sources were used in this work; glucose, sucrose, and maltose. Glucose was the best carbon source and maltose the poorest for the production of polysaccharide material. Glutamic acid was the best source of nitrogen. Choline and PABA had a slight stimulatory effect on the polysaccharide synthesis; a variety of other vitamins had virtually no effect.

Dextrin, used as a primer, did not exhibit any effect on polysaccharide production, nor did ratios of nitrogen; phosphate other than the above. Amino acids other than glutamic acid did not result in polysaccharide synthesis.

Isolation procedures provided relatively pure polysaccharide material. In all cases the nitrogen content of the polysaccharides was less than one per cent and the ash content ranged from 0.90% to 2.22%.

Several different analytical methods were used to characterize the polysaccharide material: chromatography, electrophoresis, infra-red analysis, methylation, derivative formation and qualitative chemical tests for carbohydrates. The components of the polysaccharides were determined by first hydrolyzing them (acid and enzymatic) and then examining the hydrolyzates. Chromatography, qualitative sugar tests, and electrophoresis of the hydrolyzates revealed that the only component present was glucose. This was verified by the formation of osazones and by the action of the enzyme, glucose oxidase. No other components were found to be present in the hydrolyzates (acid and enzymatic) by any of the above analytical methods used individually or in combination.

The action of the enzymes diastase (Taka-Diastase) and cellulase on the polysaccharides was found to be identical to their action on dextrin. Hydrolysis by diastase resulted in the liberation of two substances, glucose and maltose, while cellulase hydrolysis resulted in the liberation of glucose only.

Chromatography, electrophoresis, infra-red examination, and methylation reactions conducted on the polysaccharides showed them to be polymers of glucose. The polymers were straight chain molecules linked at the 1-4 positions; no branching was detected in these glucose chains.

Nine polysaccharides produced by several wood rot fungi in a chemically defined medium were isolated in a relatively pure state. They were qualitatively characterized by the previously mentioned analytical methods. These polysaccharides were found to be qualitatively identical; they were all 1-4-linked unbranched (linear) glucans.

Microfilm \$2.50; Xerox \$5.00. 97 pages.

A STUDY IN VITRO OF COMPONENTS IN THE TRANSMISSION CYCLE OF SWINE INFLUENZA VIRUS PROPOSED BY SHOPE

(L. C. Card No. Mic 60-2558)

Ward Davis Peterson, Jr., Ph.D.
University of Michigan, 1960

From information gained during studies upon the epidemiology of swine influenza, Shope decided that swine influenza virus is transmitted in a "masked" state by lungworms via earthworms to new porcine hosts, where virus becomes "unmasked." Further progress upon the transmission cycle of swine influenza virus has been hampered by costly and complex experimental requirements.

The present investigation was initiated to develop and use *in vitro* methods to study directly the interactions of influenza virus with swine lungworms, swine lung, and earthworms, each a component of the virus transmission cycle proposed by Shope.

Extracts prepared from lungworms inhibit hemagglutination of indicator virus, but not of active virus. Properties of the inhibitor are similar to those of virus receptor substances.

After addition of infectious virus to culture medium containing lungworms, virus could be recovered in declining amounts from lungworms for a period of at least ten days. Although virus is present in that medium for significantly longer periods of time than in medium in which lungworms are absent, or in which minced or killed lungworms are present, an increase of infectious virus or hemagglutinins could not be shown.

Extracts prepared from swine lung inhibit hemagglutination of active virus at low dilutions, and hemagglutination of indicator virus at significantly higher dilutions. The activity against active virus is heat labile; that against indicator virus is heat stable. Inhibitor is destroyed at a rate slower than that of inhibitors found in lungworms and in swine lung mucus. The possibility that the reactions are due to a unique inhibitor in swine lung is discussed.

Influenza viruses grow well in epithelial-like cells derived from swine lung, without cytopathic effect or hemagglutinin production. Upon continued passage, these characteristics of viral growth in lung cells did not change. However, growth of the tissue culture line of virus is restricted in comparison with that of the original line when inoculated into embryonate eggs or mouse lung. Other evidence of adaptation of virus is provided by comparing

the rates of destruction found *in vitro* when lungworm and mucus inhibitors are treated with active virus of the two lines. The tissue culture line of virus destroys these inhibitors at a faster rate than does the original line.

Extracts prepared from earthworms do not inhibit hemagglutination of active or indicator viruses. Virus could not be shown to infect intact, living earthworms or minced tissues prepared from them maintained in culture.

In conclusion, manipulation *in vitro* of components in the transmission cycle of swine influenza virus has proven feasible, providing new information as follows: 1) Adsorption of virus to lungworms occurred and was probably mediated through virus-receptor substances. Subsequent multiplication of virus could not be shown nor could a decision be reached as to whether virus becomes "masked" in lungworms. 2) Virus multiplied in primary cultures of swine lung. Significant changes in the virus occurred upon passage in these cells. Variants were found that had restricted growth in other hosts commonly used for isolation of influenza virus. 3) No interactions of virus with earthworms could be shown, suggesting that the role of the earthworm in the transmission cycle is only that of intermediate host for the lungworm.

Microfilm \$2.50; Xerox \$4.00. 71 pages.

BOTANY

CYTOTAXONOMIC STUDY OF SELECTED
INDIGENOUS AND INTRODUCED SPECIES
OF THE GENUS *Ilex*, COMMONLY
GROWN IN THE UNITED STATES.

(L. C. Card No. Mic 60-1523)

John Lowry Frierson, Ph.D.
University of South Carolina, 1960

Using a conventional squashing and staining method for chromosome study, twenty selected native and introduced species of *Ilex* were examined cytologically.

Of these species studied, new chromosome numbers were reported for fifteen. Thirteen of these species have no previously reported chromosome numbers. New chromosome numbers for two species which had been reported previously by other workers, were found. Chromosome numbers for five species which had been reported by other workers, were confirmed.

Grafting studies indicated that divergent evolution has occurred in the *Ilex*, since grafts succeeded better when made within a subgenus than when made between subgenera. Differences in chromosome number also influenced grafting compatibility, when compatibility was measured in terms of growth.

Polyploidy in several of the species was correlated with a fossil record for those species of at least Tertiary Period. Species that were not polyploid or that did not seem to contain polyploid cells seemed to be of a Recent or Quaternary origin.

In nineteen of the twenty species studied, the chromosome number was the same, $2n = 40$. One species was

found to have a somatic chromosome number of 110. A few polyploid cells having 80 chromosomes were observed in three species that basically had a $2n$ chromosome number of 40. Most of the living *Ilex* having a $2n$ chromosome number of 40 seem to be stable diploids that have been derived through polyploidy sometime in the remote past.

Micromutations are suspected as being the chief processes in the evolution of stable new species. Alterations in chromosome number may lengthen the time of survival for a particular species, but ultimately these alterations, whether they be aneuploidy or polyploidy, seem to be paths to extinction for a species. With the exception of the influence of man's experimentation, the same evolutionary trends that have occurred in the past will probably occur in the future. Microfilm \$2.50; Xerox \$5.60. 115 pages.

A STUDY OF *PRUNUS CERASUS* VAR.
MONTMORENCY IN WESTERN NEW YORK:
INTERRELATIONS OF ROOTSTOCK, SOIL
COMPOSITION, ROOT AND SOIL POPULATIONS
OF STYLET-BEARING NEMATODES, LEAF
COMPOSITION, FRUIT QUALITY, YIELD,
AND TREE VIGOR.

(L. C. Card No. Mic 60-2493)

John David Kirkpatrick, Ph.D.
Cornell University, 1960

A very extensive literature review is provided to furnish a source of reference to previously recorded

observations of natural occurring and artificially imposed factors influencing cherry tree performance.

The purpose of the work undertaken was to study in detail some of those factors which might influence growth and productivity of the Montmorency sour cherry. The basic study utilized a survey technique employing the theory of stratified sampling in which 64 mature, commercial orchards were selected and stratified according to rootstock, soil potassium level, age, and soil type. Four adjacent "uniform," apparently healthy trees, were selected in each orchard and studied individually and in detail. Trees in 4 commercial orchards with known histories of incidence of virus diseases were studied individually for the effect of ring spot and sour cherry yellows upon the major nutrient element composition of the leaves and upon tree growth. To investigate some of the aspects revealed by the basic study, fertilizer field experiments were established in 4 mature commercial orchards. The treatments that were combined in factorial arrangement were 3 levels of nitrogen, 2 levels of phosphorus, 4 levels of potassium, and 2 levels of an experimental nematocide.

The rootstock upon which the Montmorency sour cherry is propagated greatly influences the relationships between and among the following: the readily available nutrient elements of the soil, soil pH, base exchange capacity, and soil organic matter; the stylet-bearing nematode populations in the roots and in the soil; the concentrations of the major nutrient elements in the leaves; internal fruit quality factors; fruit size; yield, terminal length and diameter; and leaf size. Coefficients of simple correlation were calculated between 4,262 sets of observations and partial regression statistics were resorted to in 109 cases using the major nutrient element composition of the leaves as independent variables.

The rootstock species strongly influences the concentrations of potassium, magnesium, and phosphorus in the leaves.

The relation of the leaf curl potassium deficiency symptom with the concentration of potassium in the leaves and the level of readily available potassium in the soil suggests that Montmorency trees on *Prunus mahaleb* rootstocks should receive closer attention to their potassium nutritional status at much higher levels of readily available potassium in the soil than those on *P. avium* rootstocks.

The relations of yield, fruit size, terminal length and diameter, tree vigor, and population levels of various stylet-bearing nematodes in the roots and in the soil with the nutritional status of the tree that were predicted by using leaf composition in combination with partial regression statistics as the criterion of tree nutritional status agreed very closely with those obtained using the levels of soil applications of nitrogen, phosphorus, potassium, and an experimental nematocide as the criterion of tree nutritional status.

High tree vigor depended upon the rate of soil applications of potassium and/or nitrogen, depending upon local variations, in combination with soil applications of phosphorus and a nematocide.

The stylet-bearing nematode population levels in the roots and in the soil were strongly influenced by the nutritional status of the tree.

The stylet-bearing nematode genera associated with the cherry tree roots and soil in a wide range of soil series were determined.

The virus status of the tree affected the concentrations of the major nutrient elements in the leaves as well as tree vigor.

Potassium sulfate and potassium chloride were comparable as sources of potassium in the absence of soil applications of phosphorus in their effect upon yield, fruit size, terminal length, tree vigor, and leaf size.

Microfilm \$17.55; Xerox \$62.70. 1393 pages.

CHEMISTRY

CHEMISTRY, ANALYTICAL

RADIOCHEMICAL SEPARATION OF CADMIUM AND THE APPLICATION OF VACUUM DISTILLATION OF METALS TO RADIOCHEMICAL SEPARATIONS

(L. C. Card No. Mic 60-2525)

James Rollo DeVoe, Ph.D.
University of Michigan, 1960

The purpose of this research was to evaluate and develop radiochemical separation procedures of the elements. Radioactive tracer techniques were used to measure the degree of separation of the desired element from a large number of elements, which have been selected on the basis of their being representative of the groupings in the periodic table.

An evaluation of the radiochemical separations of cadmium was made by studying the separation by solvent extraction with dithizone in basic media, by ion exchange in hydrochloric acid solution, and by two precipitation methods, one with a complex inorganic precipitant, (Reinecke salt) and the other with an organic precipitant [2-(o-hydroxyphenyl) benzoxazole]. The separation by dithizone and ion exchange resulted in a yield of cadmium of 78% with decontamination factors of 10^3 for twenty elements. Although the organic precipitant appeared to be

selective for cadmium, a poor separation was obtained as a result of occlusion of the contaminants on the gelatinous, flocculent precipitate. In contrast to this, the precipitate of cadmium Reineckate was very crystalline, and a separation of cadmium with a yield of 78% and decontamination factors of 10^3 for fifteen elements was obtained.

In order to determine the feasibility of radiochemical separations by vacuum distillation of the elemental state, an exploratory evaluation of the method was made. A simple vacuum distillation apparatus was designed which consisted of a carbon rod furnace heated by induction. The apparatus produced an equilibrium pressure of 6×10^{-4} mm. of Hg after five minutes of evacuation. The radioactive distillate was collected on Teflon film which was wrapped around a liquid nitrogen cold finger.

The bimetallic systems Cd-Zn, and Cd-Ag were studied in order to measure the degree of separation of cadmium that could be obtained by distillation from various atom ratios of cadmium to zinc or silver. The separation that was observed with these metal systems was compared with the theoretical degree of separation when it was assumed that an ideal solution existed, and the discrepancy between theory and experiment was discussed.

Separation procedures which were evaluated include the separation of trace amounts of mercury by chemical

reduction onto a copper foil with subsequent distillation of the mercury, and by electrolysis of cadmium (1 mg.) onto copper foil (or into a mercury cathode with volatilization of the macro mercury) followed by distillation of the cadmium. For the separations of cadmium the radiochemical reduction step resulted in limited separation; however, the distillation step improved the over-all separation so that it was possible to obtain a degree of separation which was comparable to that which was obtained in the separations by extraction and ion exchange. The radiochemical reduction of mercury was selective in itself, and the distillation of the mercury resulted in an over-all separation of mercury with a yield of at least 72% and decontamination factors of 10^4 for twenty elements.

A very useful application of the vacuum distillation technique was found in the separation of a volatile carrier free daughter from a macro amount of a less volatile parent metal, such as the separation of indium 113m from neutron irradiated tin. From this type of system, vacuum distillation can provide a method for preparing very thin high specific activity counting sources.

Microfilm \$2.50; Xerox \$5.00. 100 pages.

CHEMISTRY, BIOLOGICAL

MICROBIAL RIBOFLAVIN BIOSYNTHESIS AND THE ISOLATION OF A NEW GUANINE DERIVATIVE

(L. C. Card No. Mic 60-2505)

Usama A. S. Al-Khalidi, Ph.D.
University of Michigan, 1960

The mold *Eremothecium ashbyii* is one of a number of organisms which synthesize riboflavin at an exaggerated rate. Previous studies in various laboratories with these organisms have established that purines are precursors of the pyrimidine ring in the riboflavin molecule and have given some suggestion as to the nature of the precursors of the other parts of the molecule. However, with the possible exception of one compound, 6,7-dimethyl-8-ribitylumazine, intermediates in the biosynthesis of riboflavin have not been discovered.

This study was an attempt to isolate and identify intermediates in riboflavin biosynthesis. The involvement of guanine as a more direct precursor than adenine in the biosynthesis of riboflavin was suggested by some of our experiments, which showed that guanine is incorporated into riboflavin and into nucleic acid guanine but is not converted to nucleic acid adenine to an appreciable extent. Therefore, guanine apparently is not converted to the adenine level in *E. ashbyii*.

A study of the acid-soluble fraction of *E. ashbyii* at various stages of growth was undertaken using the techniques of ion-exchange and paper chromatography. Radioactive guanine was used to help in the detection of riboflavin intermediates. However, such intermediates could not be detected in this fraction.

A study of inhibitors of riboflavin synthesis also was undertaken. Five compounds which showed a preferential inhibition of flavinogenesis over growth were tested to determine whether they would bring about an accumulation of

riboflavin intermediates. In these experiments guanine-2- C^{14} , which leads to the labeling of riboflavin and guanine-8- C^{14} , which does not, were added to parallel incubation mixtures. Compounds labeled with guanine-2- C^{14} but not guanine-8- C^{14} were sought by paper chromatography. But unfortunately, intermediates could not be detected by these techniques. This failure can be explained in part by the realization that these inhibitors may have been depressing the synthesis of purines so that the remaining purines were siphoned into nucleic acid formation rather than into riboflavin biosynthesis.

Attempts were made to demonstrate the incorporation of radioactive guanine into riboflavin in cell-free extracts. However, the level of incorporation obtained was too low to be useful in further studies. The incorporation was not improved by supplementing these extracts with various additives.

In the course of these investigations a new compound which became labeled by C^{14} guanine, accumulated during incubation of the cell-free extracts. After acid hydrolysis of the reaction mixture, the new compound apparently was degraded to a derivative with acidic properties. This derivative was purified by chromatography and other techniques and finally isolated in a crystalline state. It was stable in acidic and alkaline solutions. By prolonged refluxing in neutral solution, it decomposed to yield guanine and L-lactic acid in stoichiometric quantities. It also was decomposed by refluxing in 6 N HCl to form xanthine, alanine, glycine and lactic acid in a quantitative yield.

The elemental analysis of the crystalline material agreed with the empirical formula $C_8H_9N_5O_3 \cdot 1/2 H_2O$.

The degradation studies and the elemental analysis identified the compound as propionoguanine. The stoichiometry found on 6 N HCl degradation, the ultraviolet absorption spectra in neutral and alkaline solutions, the resistance of the compound to deamination with nitrous acid, and the bulk of evidence in general leads to the tentative assignment of the amino group of guanine as the point of attachment of the three carbon acid residue. However, certain other experimental observations appear inconsistent with this formulation.

It seems possible that a derivative of propionoguanine is an intermediate in riboflavin synthesis, since it accumulates in relatively large quantities in extracts and approximately in proportion to the rate of riboflavin synthesis in the original culture.

Microfilm \$2.50; Xerox \$5.80. 119 pages.

I. CORN PROTEIN STUDIES.

II. A FACTOR IN CORN WHICH IMPROVES THE GROWTH OF RATS ON AMINO ACID DIETS. III. STUDIES ON AMINO ACID REQUIREMENTS.

(L. C. Card No. Mic 59-6265)

Ricardo Bressani, Ph.D.
Purdue University, 1956

Major Professor: Edwin T. Mertz

I. Studies on Corn Proteins

To conserve space, the reader is referred to the published data which have appeared in Cereal Chemistry.

Publication No. 1. Studies on Corn Proteins. I. A new method of extraction. E. T. Mertz and R. Bressani. 34, 63-69 (1957). II. Electrophoretic analysis of germ and endosperm extracts. E. T. Mertz, N. E. Lloyd and R. Bressani. 35, 146-155 (1958). IV. Protein and amino acid content of different corn varieties. R. Bressani and E. T. Mertz. 35, 227-235 (1958).

II. A Factor in Corn Which Improves the Growth of Rats on Amino Acid Diets

III. Studies on Amino Acid Requirements

1. The relationship of protein level to the minimum lysine requirement of the rat.

To conserve space, the reader is referred to the publication covering this material: R. Bressani and E. T. Mertz. Relationship of protein level to the minimum lysine requirement of the rat. *J. Nutrition*, 65, 481-492 (1958).

2. The minimum histidine requirement of the rat.

The minimum histidine requirement of the growing rat was determined with an 88 per cent corn-amino acid diet and a 30 per cent corn-amino acid diet. With these rations, the requirement was found not to exceed 0.23 per cent of the diet. This value is approximately one-half the value found by other workers.

3. Phenylalanine studies on the rat.

The phenylalanine requirement of the growing rat was estimated using corn-amino acid diets and purified amino acid diets. With the semi-purified diet, a requirement of 0.33 per cent phenylalanine was found when 0.14 per cent tyrosine was in the diet. The requirement as determined with purified diets was 0.62 per cent of the diet when 0.12 per cent tyrosine was present in the diet, and 0.70 per cent when no tyrosine was present. Better growth was obtained with the corn-amino acid diets than with the purified amino acid diets at comparable levels of phenylalanine and tyrosine. A hot water extract from corn gluten induced about 11 per cent more growth in rats fed purified amino acid diets than rats fed only the purified diets without the addition of the hot water extract. The difference, although small, was found to be significant at the 1 per cent level of significance. It was found that more favorable growth of rats is obtained when both phenylalanine and tyrosine are added to purified diets than when the requirements for the aromatic amino acids are met by phenylalanine alone. The D- form of phenylalanine is slightly less efficiently utilized than the L- form in corn-amino acid diets, but both forms are utilized equally well in purified diets.

Microfilm \$2.95; Xerox \$10.15. 225 pages.

EFFECT OF 2,4-DIAMINO BUTYRATE ON CEREBRAL METABOLISM OF γ -AMINO BUTYRIC ACID.

(L. C. Card No. Mic 60-2544)

David Harry Kessel, Ph.D.
University of Michigan, 1960

In an attempt to discover the basis for the neurotoxic action of 2,4-diaminobutyric acid upon injection into rats, reported by Christensen and Riggs, it was found that this compound could cross the blood-brain barrier. Chromatographic studies revealed that the entrance of diaminobutyrate into cerebral tissue *in vivo* is accompanied by an elevation of the cerebral level of γ -aminobutyric acid. This same effect can be produced *in vitro* by either diaminobutyric or 2,3-diaminopropionic acid. Both of these amino acids are substrates for the γ -aminobutyric transaminase preparation described by Roberts, and both are able to competitively inhibit transamination of γ -aminobutyrate. Diaminopropionate is non-toxic *in vivo*, presumably because it cannot cross the blood-brain barrier.

Substantial quantities of γ -aminobutyrate are present in brain, and there is evidence that it, or a closely related substance, is concerned with the regulation of nerve impulses in brain. Earlier work by Bessman and by Roberts established that a B_6 -requiring decarboxylase converts glutamic acid to γ -aminobutyrate in brain, and that a B_6 -requiring transaminase converts γ -aminobutyrate to succinic semialdehyde. The semialdehyde is subsequently oxidized to succinate which is metabolized via the tricarboxylic acid cycle.

In the present work, measurements of the incorporation of radioactivity from C^{14} -glutamic acid into γ -aminobutyrate by cerebral tissue indicated that the excess γ -aminobutyrate present in diaminobutyrate-treated brains was formed via decarboxylation of glutamate. No enhancement of γ -aminobutyrate production could be attributed to diaminobutyrate. Cerebral tissue removed from animals ten hours or more after diaminobutyrate injection showed impairment of both glutamic decarboxylase and γ -aminobutyric transaminase activities. Diaminobutyrate also inhibited both enzymes *in vitro*, but the inhibition of the decarboxylase could be reversed by excess pyridoxal phosphate. Deficiency of B_6 is known to cause inactivation of this enzyme *in vivo*. Hence, the effect of diaminobutyrate on glutamic decarboxylase is in the wrong direction to explain accumulation of γ -aminobutyrate by cerebral tissue. Furthermore, inhibition of decarboxylase activity is produced *in vivo* only after prolonged exposure of brain to the action of diaminobutyrate.

In contrast, γ -aminobutyrate catabolism is inhibited by diaminobutyrate, even in the presence of excess pyridoxal phosphate. Although enzymatic conversion of radioactive γ -aminobutyrate to carbon dioxide was slowed by diaminobutyrate *in vitro*, no metabolic step subsequent to γ -aminobutyrate transamination was affected. Since diaminobutyrate competitively inhibits γ -aminobutyrate transamination, it is concluded that the accumulation of γ -aminobutyrate observed *in vivo* upon diaminobutyrate administration can be explained by this inhibition.

Earlier work showed that convulsive behavior and cerebral damage resulted when diaminobutyrate was injected into rats. The gradual decline of glutamic decarboxylase activity in mouse brain after diaminobutyrate injection suggests that the presence of this compound

simulates B₆ deficiency *in vivo*. The importance of these findings in the light of known effects of B₆ deficiency are discussed. Microfilm \$2.50; Xerox \$6.40. 134 pages.

FACTORS AFFECTING THE DISTRIBUTION
OF AN UNMETABOLIZABLE AMINO ACID,
 α -AMINOISOBUTYRIC ACID, IN MAN.

(L. C. Card No. Mic 60-2547)

Richard Stanley Kowalczyk, Ph.D.
University of Michigan, 1960

The distribution in man of α -aminoisobutyric acid 1-C¹⁴ has been studied. The inability of this amino acid to undergo measurable metabolic change allows it to be identified in body fluids in an unchanged form by means of its radioactive label and allows study of the transport of amino acids separated from effects influencing the anabolism and catabolism of amino acids.

In a preliminary study, urinary excretion of labeled α -aminoisobutyric acid by subjects who had received orally from 0.01 to 1.5 mmoles of the amino acid per kg. body weight was followed. From 20 to 37 per cent of the administered dose appeared in the urine in six hours. Up to a dosage level of 0.5 mmoles per kg., the excretion rate increased in proportion to the dose size. Above this dosage level, the excretion rate increased more rapidly than dose size. No differences were observed between children and adults either in the per cent of dose excreted or the rate of excretion. α -Aminoisobutyric acid administered orally appeared in the urine as rapidly and in as large amounts as a similar dose given by intramuscular injection. α -Aminoisobutyric acid is cleared much more rapidly by the kidney than the naturally occurring amino acids. This is attributed to a very low value for the maximum tubular reabsorptive capacity of the kidney for this amino acid.

The level of α -aminoisobutyric acid in the plasma after a standard dose of 1.4 μ C per kg. body weight was found to be lower in children than in adults. Because the percentage of the amino acid left is no greater in adults than in children, this means that the levels in other compartments (presumably cellular) must be greater in children. As a simple means of expressing the extent of concentration into such compartments, the volume required to contain the residual α -aminoisobutyric acid in the body at the same concentration as in the plasma was calculated. This value, the apparent volume of distribution is greater in children and reflects the greater stimulus of growth.

The serum level of α -aminoisobutyric acid was depressed and the apparent volume of distribution elevated in one of five patients studied who had clinical symptoms of acromegaly. This same patient was the only one of the five who showed clinical signs of active acromegaly. The serum level was apparently depressed in response to an excess of circulating growth hormone in this subject.

In two subjects with a lipotrophic diabetes, the administration of 5 mg. of human growth hormone had no noticeable influence on the serum level of α -aminoisobutyric acid, although the apparent volume of distribution was elevated in both. In a subject with panhypopituitarism, the serum level of the amino acid was lowered and the volume of distribution elevated after two 25 mg. doses of human growth hormone.

Two patients with Cushing's disease showed high levels of α -aminoisobutyric acid after a standard dose of α -aminoisobutyric acid while one patient receiving high doses of corticosteroids showed normal serum levels. In each the urinary excretion appeared to be elevated and the apparent volume of distribution was low.

These observations show the ability of the hormonal agents studied to influence the transport of amino acids in man and suggest the use of labeled aminoisobutyric acid as a means of detecting disturbances of amino acid distribution in various disease states.

Microfilm \$2.50; Xerox \$5.20. 104 pages.

STUDIES OF GLYCINE OXIDATION IN RAT TISSUES

(L. C. Card No. Mic 60-2620)

Henry Isao Nakada, Ph.D.
Temple University, 1953

Although glycine is known to be readily utilized in quantity by the intact animal, demonstration of its oxidation by tissue preparations *in vitro* has not been successful. Since the usual methods of studying amino acids failed when applied to glycine, a study of glycine oxidation in various rat tissues was undertaken using radiocarbon labeled compounds. Using this technique the oxidation of glycine was demonstrated by rat liver and kidney but only slightly or not at all by rat spleen, lung, heart, muscle, brain, mouse rhabdomyosarcoma or mouse hepatoma. The pathway of glycine metabolism in rat liver established in this study may be formulated in the following scheme:

1. $\text{H}_2\text{NCH}_2\text{-COOH} \rightarrow \text{OHC-COOH} + \text{NH}_3$
2. $\text{OHC-COOH} + \frac{1}{2}\text{O}_2 \rightarrow \text{HCOOH} + \text{CO}_2$
3. $\text{OHC-COOH} + \frac{1}{2}\text{O}_2 \rightarrow \text{HOOC-COOH}$
4. $\text{HCOOH} + \text{H}_2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
5. $\text{HOCH}_2\text{-COOH} + \text{DPN} \rightarrow \text{OHC-COOH} + \text{DPN}\cdot\text{H}_2$

The occurrence of step 1, the interconversion of glycine and glyoxylate was established by isolating radioactive glycine after glyoxylate-1,2-C¹⁴ was incubated with liver tissue and by isolating and degrading radioactive glyoxylate after glycine-2-C¹⁴ was incubated with rat liver tissue. A direct conversion was indicated by the fact that the glycine alpha carbon was found only in the glyoxylate alpha position. Glycine formation from glyoxylate was shown to occur by a transamination reaction and glutamic acid or glutamine was found to be the most active amino group donor for glycine. This transamination occurs both enzymatically and non-enzymatically.

The oxidation of glyoxylate to formate and CO₂ (step 2) has not yet been characterized enzymatically. The competitive inhibition of pyruvate oxidation by glyoxylate, and the decrease in both pyruvate and glyoxylate oxidation by the livers of thiamine deficient rats, indicates that these two acids may be acted on by the same or similar enzymes. Evidence for a different pathway for the decarboxylation of glyoxylate is that glutamic acid greatly enhances glyoxylate oxidation. The naturally occurring isomer of glutamic acid appears to be specific in this effect, other amino acids, coenzymes, D(-)glutamic acid, and glutathione are

inactive. Since this enhancement has been found to be the greatest when the concentrations of glyoxylate and glutamate are equal, a Schiff's base type condensation between these two compounds has been postulated.

The oxidation of glyoxylate to oxalate has already been shown by Ratner, Nocito and Green and confirmed by us to be catalyzed by xanthine oxidase, and this reaction has been demonstrated to occur in rat and pigeon livers. This is not regarded as a normal pathway of glyoxylate metabolism, however, since oxalate formation apparently occurs to an appreciable extent only when glyoxylate concentration is unphysiologically high.

Although the mechanism of step 4, the oxidation of formate to CO_2 is not entirely clear, the available evidence indicates that this process represents a peroxidative function of catalase. The mechanism for this reaction as worked out by Keilin and Hartree and by Chance is that the hydrogen peroxide formed in oxidative reactions can couple with catalase to form a complex, and this complex is capable of dehydrogenating several compounds including formate.

Because glycolate and glyoxylate behave similarly in forming glycine and oxalate, the interconversion of these two compounds was considered to be of sufficient interest to study. The DPN (diphosphopyridine nucleotide) dependent lactic acid dehydrogenase was found to rapidly catalyze this interconversion.

Since it is well known that glycine forms serine which can be further oxidized via pyruvate and the citric acid cycle, experiments were conducted in order to determine whether this pathway or direct oxidation via glyoxylate was more rapid. A comparison between the radioactivity of the respiratory CO_2 , formate, acetoacetate and serine found after incubating glycine-2- C^{14} with rat liver slices indicates that direct oxidation by way of glyoxylate formation is probably the predominant reaction.

The data establish the following pathway of glycine oxidation in rat liver: glycine \rightarrow glyoxylate \rightarrow CO_2 + formate \rightarrow CO_2 . Microfilm \$2.50; Xerox \$6.20. 130 pages.

THE BIOSYNTHESIS OF THE ESSENTIAL AMINO ACIDS, ARGININE, LYSINE, AND VALINE, BY THE YEAST *TORULOPSIS UTILIS*.

(L. C. Card No. Mic 60-2624)

Murray Strassman, Ph.D.
Temple University, 1953

To obtain information concerning the biosynthesis of the essential amino acids, arginine, lysine, and valine, the yeast *Torulopsis utilis* was grown on a glucose medium containing tracer amounts of various simple compounds of biochemical nature, labeled with carbon 14. The amino acids were isolated from the cell material and were degraded chemically to determine how the radioactive carbon was distributed in their molecules. From the information obtained mechanisms for the synthesis of these substances were proposed.

It was found that the ornithine moiety of arginine synthesized in the presence of methyl- and carboxyl-labeled acetate, methylene- and carboxyl-labeled glycine, carboxyl-labeled lactate, and formate had the distribution of labeled carbon which would be expected in alpha-ketoglutarate formed during the intermediary metabolism of these

labeled substances via the citric acid cycle. It was therefore concluded, in confirmation of earlier studies, that the intact alpha-ketoglutarate carbon skeleton is the direct source of the 5-carbon chain of arginine, presumably via glutamate, ornithine and citrulline.

Lysine isolated from yeast grown in glucose in the presence of tracer amounts of methyl- and carboxyl-labeled acetate had a distribution of activity which indicated that its carbon chain is built up through a combination of acetate with the succinate moiety of alpha-ketoglutarate. Similar experiments with methylene- and carboxyl-labeled glycine, carboxyl-labeled lactate, and formate are in accord with this assumption. Two possible mechanisms are suggested for the formation of the lysine carbon chain: (1) the methyl group of acetate may condense with the carbonyl carbon of an unsymmetrical succinate derivative such as succinyl-coenzyme A, or (2) the acetate methyl carbon may condense with the carbonyl carbon of alpha-ketoglutarate to give a 7-carbon homologue of citric acid, which by undergoing a sequence of reactions analogous to those of the citric acid cycle, could yield the lysine precursor, alpha-aminoadipic acid.

Similar studies, involving the biosynthesis of valine have shown how the carbon atoms of acetate and glycine and the carboxyl carbon of lactate enter the carbon chain of this amino acid. However, the data at hand are incomplete and further investigation of this problem is necessary before a plausible mechanism for valine synthesis in yeast can be proposed. Microfilm \$2.50; Xerox \$4.60. 87 pages.

A STUDY OF FATTY ACID OXIDATION IN ANIMAL TISSUE

(L. C. Card No. Mic 60-2625)

Murray Edward Volk, Ph.D.
Temple University, 1953

Employing isotopically labeled palmitic acid, the oxidation of this naturally occurring fatty acid has been studied successfully *in vitro*. Slices, whole homogenates, and washed broken cell suspensions of various animal tissues were used.

The C_{12} to C_{18} fatty acids containing an even number of carbon atoms comprise the major proportion of these lipid constituents present in and available to animal cells. The catabolism of fatty acids had been studied mainly by measuring changes in oxygen uptake on addition to substrates to surviving slices and homogenates. This technique, although successful in clarifying many of the aspects of the catabolism of short chain fatty acids (2 to 10 carbon atoms), has proved difficult to apply to the long chain fatty acids for a variety of reasons. Consequently, less information has been available concerning the metabolism of these physiologically important compounds.

Through the use of palmitic acid containing excess C^{13} in the carboxyl carbon atom, the oxidation of palmitic acid added to surviving preparations of rat liver has been demonstrated independently of oxygen consumption data. Evidence for the oxidation was the appearance of excess C^{13} in both the respiratory CO_2 and acetoacetate produced by slices, whole homogenates, and washed broken cell suspensions of rat liver.

In contrast to octanoic acid, which is transformed preponderantly to ketone bodies by liver homogenates, palmitic

acid is converted equally to carbon dioxide and to acetoacetate, as shown by parallel experiments using aliquots of the same tissue preparation.

From a study of the oxidation of palmitic acid by broken cell preparations of liver it appears that the same cofactors (and probably the same enzymes) are involved in the oxidation of palmitic acid as in the oxidation of the short chain fatty acids. The required cofactors are Mg ion, adenosinetriphosphate (ATP), and cytochrome c. In addition, the presence of component acids of the citric acid cycle affects the rate and course of palmitate oxidation. Any component member of the cycle increased the oxygen uptake of the preparations oxidizing palmitic acid by an amount considerably greater than could be accounted for by the complete oxidation to carbon dioxide and water of the added co-oxidant. With labeled palmitate, fumarate in low concentration accelerated the oxidation of palmitate to carbon dioxide, and at the same time decreased the formation of ketone bodies. The function of Mg ion appeared to be in the operation of the citric acid cycle. The cofactor requirements for palmitate oxidation are identical to those of the short chain fatty acids, and, as has been observed before, these requirements are common to both carbohydrate and fatty acid oxidation. This observation, together with the effects of citric acid cycle components on palmitate oxidation, further implicates the citric acid in the oxidation of the natural fatty acids.

Added C^{13} -carboxyl-labeled palmitic acid was oxidized by a variety of tissues other than liver, however rat brain and skeletal muscle did not appear to oxidize palmitic acid when studied by this technique.

The procedure employed for obtaining the above results, viz., adding labeled palmitic acid to surviving tissue preparations, made no attempt to duplicate physiological conditions. The second section of this study was concerned with the oxidation of fatty acids labeled *in situ*. Radioactive palmitic acid was incorporated into the lipides of tissues by feeding the C^{14} -carboxyl-labeled compound to the intact animal. The oxidation of the incorporated acid was studied in tissue slice or mince preparations. Under these conditions the tissue respiratory CO_2 arises from the endogenous metabolic activities of relatively undamaged cells. It would seem that the contribution of fatty acids to endogenous respiration could be estimated by analysis of the C^{14} content of the tissue respiratory CO_2 and comparison with that of the tissue lipides.

In a preliminary experiment the gross metabolic fate of fed palmitate was traced in the intact animal. Radioactive palmitic acid was administered to a rat. Samples of the CO_2 expired over suitable intervals of time were collected and analyzed for C^{14} activity. The maximum rate of C^{14} excretion in the respiratory CO_2 was found to occur during the third hour following feeding. Over 60 per cent of the administered isotope was excreted via this route by the end of 24 hours. The total fatty acids of all tissues tested contained significant quantities of C^{14} on analysis upon completion of the metabolic experiment.

Comparison of the C^{14} -specific activity of the respiratory CO_2 of surviving tissue slices to that of the lipides of these slices 3 hours after administration of palmitate indicated, in every tissue tested, that a very considerable fraction of their CO_2 of endogenous respiration is derived from the oxidation of long chain fatty acids. Both brain and skeletal muscle demonstrably oxidize palmitate under these conditions. It thus appears that the previously ob-

served inability of slices of brain and minces of muscle to oxidize added palmitate was due to failure of the substrate to reach intact oxidative enzymes.

In all tissues the specific activity of the respiratory CO_2 was much higher than that of the total fatty acids in experiments conducted 3 hours after ingestion of C^{14} -palmitate. Fractionation of total tissue lipides to phospholipide and glyceride fatty acids yielded no fraction with sufficient activity to account for this phenomenon. The ratio of the specific activity of the respiratory CO_2 to that of the total tissue fatty acids of each tissue was observed to decrease as the interval between palmitate administration and sacrifice was lengthened to 24 and 48 hours. A study was made of changes in the distribution of fatty acid activity between phospholipides and non-phospholipides of liver, muscle, and brain occurring over short intervals of time after C^{14} -palmitate administration. Within one hour the fatty acids of liver and muscle were labeled. Appreciably more radioactivity was incorporated into non-phospholipide fatty acids of liver and brain than in the phospholipide fatty acids of these tissues in three hours, but the difference in radioactivity of these lipide fractions tended to decrease with time.

The results of these studies of the rate of equilibration of palmitate with tissue lipides are consistent with a concept of cellular fatty acid oxidation involving the preferential oxidation of fatty acids recently entering the cell cytoplasm rather than of those contained in intracellular structures. The data substantiate other evidence that phospholipides are not obligatory intermediates in the transport of fatty acids into cells.

The incorporation and utilization of ingested C^{14} -palmitate by rat hepatoma tissue was studied. Little difference between the metabolic pattern of tumor and of normal tissue was found in respect to metabolism of lipide.

In connection with previous work of this laboratory concerned with the mechanism of acetoacetate formation, the acetoacetate formed in these experiments was collected and degraded. Like the acetoacetate formed from added carboxyl-labeled, short chain fatty acids, endogenous acetoacetate produced by slices of liver containing labeled fatty acids was labeled equally in the carboxyl and -carbons, and thus appeared to have been formed by random recombination of identical 2-carbon fragments.

The results of several promising but incomplete studies touched upon in the course of these investigations are presented and discussed.

Microfilm \$2.50; Xerox \$5.60. 118 pages.

CHEMISTRY, ORGANIC

AN INVESTIGATION OF DERIVATIVES OF YOHIMBINE AND A STUDY OF THE NAPHTHYRIDINES

(L. C. Card No. Mic 60-2540)

Allan Eugene Hydorn, Ph.D.
University of Michigan, 1960

The reduction of yohimbine with lithium aluminum hydride yields yohimbyl alcohol, from which the mono-*p*-toluenesulfonic acid ester can be prepared by treatment

with tosyl chloride in pyridine at low temperatures. It was found that when the tosyl ester was subjected to acidic hydrolysis in aqueous ethanol, yohimbyl alcohol was regenerated. But when basic hydrolysis was attempted, a molar equivalent of p-toluenesulfonic acid was removed from the molecule, resulting in a crystalline solid whose molecular formula was reduced by the elements of water from that of yohimbyl alcohol.

It was readily apparent that this substance was most probably one of two structures, either a 15(16)-unsaturated 16-methyl-yohimbol or 16,17-yohimbyloxetane. Conclusive evidence for either of these structures was not available from the infrared spectrum. Consequently, many various attempts to reduce or to oxidize the possible double bond were performed without success. Attempted oxidation of the C-17 secondary alcoholic function to a possible α,β -unsaturated ketone failed to yield even the anticipated C-17 ketone, which was a partial indication that the secondary hydroxyl group no longer existed. Since the alternative structure consisted of a four-membered cyclic ether, which could be cleaved by lithium aluminum hydride, such a reduction was attempted. The product isolated was indeed the expected 16-methyl-yohimbol which could then easily be oxidized to 16-methyl-yohimbone.

The tosyl ester was also utilized in an attempt to alkylate sixteen amines, five of which (n-butylamine, piperidine, benzylamine, cyclohexylamine and 1-diethyl-amino-4-aminopentane) formed characterizable compounds. With the low-boiling isopropylamine, t-butylamine and ethylenediamine no reaction occurred. In the cases of aniline, N-hydroxyethylpiperazine, di- β -cyanoethylamine and di-n-butylamine, tar formation was so extensive that no alkylation product could be isolated from the reaction mixtures. When alkylation of solid amines was attempted in various solvents, no reaction could be effected, as the solids were recovered unchanged.

In the naphthyridine system, it was hoped that with the formation of the N-oxides of the various isomers by treatment of the bases with hydrogen peroxide in acetic acid that it might then be possible to induce electrophilic substitution into the extremely inert naphthyridine rings. 1,5-Naphthyridine 1,5-dioxide was accordingly prepared, but all attempts at nitration under a variety of conditions met with failure. A rationale for this can quite conceivably be that the temperature needed to induce electrophilic attack on the inert naphthyridine rings even when activated by N-oxide functions is above the temperature range in which the N-oxide groups are stable. These consequently decompose losing oxygen and yielding the inert naphthyridine base before electrophilic substitution can proceed.

A number of new naphthyridine derivatives including 2-chloro-1,5-naphthyridine 1,5-dioxide, 2-hydrazino-4-chloro-1,8-naphthyridine, 4-chloro-1,8-naphthyridine, 3-nitro-4-hydroxy-1,8-naphthyridine, 2-methoxy-4-chloro-1,8-naphthyridine, 4-chloro-1,8-naphthyridine 1,8-dioxide, 3-carboxy-4-hydroxy-1,6-naphthyridine and 4-hydroxy-1,6-naphthyridine were prepared.

Microfilm \$2.50; Xerox \$5.00. 96 pages.

THE SYNTHESIS OF PHOSPHONOPYRIMIDINES

(L. C. Card No. Mic 60-2649)

Clarence Henry Roy, Ph.D.
Auburn University, 1960

Supervisor: Gennady M. Kosolapoff

Nine dialkyl pyrimidylphosphonates were synthesized and characterized. Six of these esters were converted to the corresponding phosphonic acids. The phosphonate grouping was attached to the pyrimidine ring by conventional halogen displacement-type reactions; however, it was often necessary to modify the usual reaction conditions or mode of isolation in order to obtain the desired product.

The infrared and ultraviolet spectra of the pyrimidylphosphonates was recorded, and a study of their more prominent features was conducted. (Reproductions of the infrared spectra are included in the dissertation.)

The results obtained are summarized as follows:

1. Diethyl 4,6-dimethyl-2-pyrimidylphosphonate was prepared from the corresponding chloro compound by reaction with sodium diethyl phosphite.
2. Diisopropyl 2-chloro-4-pyrimidylphosphonate was synthesized by an Arbuzov reaction with 2,4-dichloropyrimidine.
3. Diisopropyl 4-pyrimidylphosphonate, diisopropyl 2-amino-4-pyrimidylphosphonate, diisopropyl 2-dimethyl-amino-4-pyrimidylphosphonate, diisopropyl 2-diethyl-amino-4-pyrimidylphosphonate and diisopropyl 2-ethoxy-4-pyrimidylphosphonate were prepared by appropriate treatment of the diisopropyl 2-chloro-4-pyrimidylphosphonate.
4. Diisopropyl 2-pyrimidylphosphonate was obtained from an Arbuzov reaction with 2-chloropyrimidine. The 2-chloropyrimidine was prepared in large quantity and good yield by an improved method for the reduction of 2,4-dichloropyrimidine.
5. Dibutyl 2-methyl-5-pyrimidylphosphonate was synthesized from 2-methyl-5-bromopyrimidine by conversion to 2-methyl-5-pyrimidyllithium and subsequent reaction with dibutyl phosphorochloridate.
6. The carbon to phosphorus bond of some of the pyrimidylphosphonates appeared to be labile under hydrolytic conditions; consequently, the phosphonic acids were obtained from the esters by treatment with anhydrous hydrogen bromide gas.

Microfilm \$2.50; Xerox \$5.60. 111 pages.

STEREOCHEMICAL STUDIES IN THE CAMPHANE AND ISOCAMPHANE SERIES

(L. C. Card No. Mic 60-2565)

Francis Siegfried Seichter, Ph.D.
University of Michigan, 1960

It has been reported that the acid isomerization product of camphene-8-carboxylic acid (I) is the beta-lactone,

isocamphane-8-carbo-2-lactone. In view of the extensive studies on camphane and isocamphane derivatives, it appeared attractive to prove that the product is not the above beta-lactone but rather (+)-camphane-10-carbo-2-exo-lactone (II) and to investigate the mechanism of this reaction.

The heretofore unknown identification of (+)-10-benzoyl-2-hydroxycamphane, prepared from camphene and acetyl chloride, as (+)-10-benzoylisoborneol (III) has been indicated by degradation to authentic (+)-isoborneol. The degradative sequence involved initial oxidation of (+)-10-benzoylisobornyl acetate to 2-exo-acetoxyapocamphane-1-carboxylic acid, from which the carboxy function was reduced to a methyl substituent by conversion, in turn, to the acid chloride, reduction to the alcohol, preparation of the ethyl sulfide via the mesylate, and desulfurization to authentic isoborneol. Compounds III and II gave the common product, diphenyl-(2-exo-hydroxy-10-camphane)-methanol (IV), m.p. 151-154°, by reaction with phenyllithium and phenylmagnesium bromide, respectively. Thus, it has been established that the acid isomerization product of I is actually II.

A mechanism which involves non-classical carbonium ion species for the formation of II from I has been concluded from a) the above stereochemical identification of II, b) the acid isomerization of optically active I to II, which is racemic, and c) an unequivocal structure proof of I. The proof of structure of I has been effected by dehydration and succeeding hydrolysis of the Reformatsky product of camphenilone and ethyl bromoacetate. Optically pure I has been synthesized by treatment of optically pure 2-endo-chloro-1-apocamphane-ethanol with silver acetate in acetic acid, followed by hydrolysis and subsequent oxidation.

An optically active modification of alpha-pinene-10-carboxylic acid has been synthesized from optically active alpha-pinene, identified by reduction to nopol, and acid isomerized to a racemic gamma-lactone (V). Reaction of V with phenylmagnesium bromide gave a diol, C₂₃H₂₈O₂ (VI) of m.p. 160-162.5°. Acetylation and subsequent dehydration of IV gave diphenyl-(2-exo-acetoxy-10-camphane)-methanol (VII) of m.p. 150-153° and 10-benzhydrylidene-isobornyl acetate (VIII) of m.p. 106-108°, the same sequence on VI gave respectively C₂₅H₃₀O₃ (IX) of m.p. 137-141° and C₂₅H₂₈O₂ (X) of m.p. 73-75°. The infrared spectra of IV and VI are very similar as are those of VII and IX and of VIII and X. Also, the ultraviolet spectra (in methanol) of VIII (λ_{\max} 2530 Å, log ϵ 4.37 and λ_{\min} 2340 Å, log ϵ 4.60) and of X (λ_{\max} 2515 Å, log ϵ 4.07 and λ_{\min} 2310 Å, log ϵ 4.50) closely resemble one another. Furthermore, hydrolysis of VIII followed by successive oxidation, stereospecific reduction, and acetolysis gave a product which is believed to be X. The above evidence indicates that V is the epimeric camphane-10-carbo-2-endo-lactone and that VI, IX, and X are the respective epimers of IV, VII, and VIII. On the basis of the presumed identity of V, a non-classical mechanism has been postulated for its formation from alpha-pinene-10-carboxylic acid.

Microfilm \$2.50; Xerox \$6.00. 121 pages.

NITRATION STUDIES. PART I. CATALYTIC EFFECTS IN VAPOR PHASE NITRATION.

PART II. NITROHALOGENATION OF NEGATIVELY SUBSTITUTED OLEFINS WITH MIXTURES OF DINITROGEN TETROXIDE AND HALOGENS.

PART III. PREPARATION OF 1,1,1-TRICHLORO-3-NITRO-2-ALKENES.

(L. C. Card No. Mic 60-2245)

Norman Weston Standish, Ph.D.
Purdue University, 1960

Major Professor: G. Bryant Bachman

Part I. Catalytic effects in vapor phase nitration. This investigation was concerned with improving the vapor phase nitration process. Specifically, the vapor phase nitration of propane with nitric acid or nitrogen dioxide was studied in the presence of additives such as organic peroxides, hydrogen peroxide, and ozone. The effects of exposure of the nitration mixtures to physical sources of energy such as ultraviolet irradiation and silent electrical discharge were also studied. Although peroxides and silent electrical discharge gave no improvement in yields, ultraviolet irradiation gave slightly improved yields of nitro paraffins and altered the distribution in favor of the highest molecular weight nitro paraffins. Ozone was outstanding in its ability to promote nitration and reduce oxidation to carbonyl compounds. Thus, the conversions to and yields of nitro paraffins found with ozonized were considerably higher than those found with an equivalent amount of oxygen.

Part II. Nitrohalogenation of negatively substituted olefins with mixtures of dinitrogen tetroxide and halogens. This investigation was primarily concerned with the liquid phase reaction of negatively substituted olefins with mixtures of dinitrogen tetroxide and halogens. Specifically, these studies showed that vinyl cyanide, 1,2-dichloroethylene, 1,1-dichloroethylene, trichloroethylene, and 1-chloropropene react with mixtures of dinitrogen tetroxide and chlorine (or bromine) to give halonitro ethanes to the practical exclusion of halonitrato ethanes. The structures of these compounds were determined by hydrolysis to halogenated acetic acids, and by the products formed in their reactions with sodium anthranilate. From the products and orientations observed certain conclusions concerning the ability of the substituted olefin to induce free radical vs. ionic additions have been made.

Part III. Preparation of 1,1,1-trichloro-3-nitro-2-alkenes. This investigation was concerned with developing a process for the preparation of nitro olefins by a continuous process. Specifically, a vapor phase condensation of chloral with nitro paraffins was studied at 360° over a magnesium sulfate-amine catalyst, and was found to give the corresponding trichloronitro olefins, and substantial amounts of the trichloronitro alcohols. Derivatives of these products were also prepared.

Microfilm \$3.55; Xerox \$12.60. 276 pages.

**CYCLIZATION OF N-ALLYLTHIOAMIDES
AND THEIR HOMOLOGS WITH PARTICULAR
ATTENTION TO THIAZOLINE SYNTHESIS**

(L. C. Card No. Mic 60-2575)

John Milton Sullivan, Ph.D.
University of Michigan, 1960

This research was undertaken to determine if the cyclization of N-allylthioamides and their homologs could be brought about generally. It was found that cyclization to either a 2-thiazoline, a 5,6-dihydro-1,3,4-thiazine, or a mixture of both occurred if the thioamide was heated with a Lewis acid.

N-Allylthiobenzamide, prepared by reaction of allyl isothiocyanate with phenylmagnesium bromide, was converted in 47% yield to 2-phenyl-5-methyl-2-thiazoline, b.p. 148-150°/18 mm., when heated with 1 equivalent of anhydrous aluminum chloride in nitrobenzene. Yields of 31% and 35% were obtained by heating the thioamide with zinc chloride or boron trifluoride etherate, respectively, without solvent.

N-Cinnamylthiobenzamide, m.p. 88-89°, was converted in 19% yield to 2,6-diphenyl-5,6-dihydro-1,3,4-thiazine, m.p. 86-88°, when heated with 1 equivalent of anhydrous aluminum chloride in nitrobenzene. The structure of the hitherto unknown product was proven by unequivocal synthesis. 3-Hydroxy-3-phenylpropylamine was benzoylated to N-(3-hydroxy-3-phenylpropyl)benzamide, which was cyclized to the desired thiazine by refluxing with phosphorus pentasulfide in toluene.

N-Crotylthiobenzamide was converted in 20% yield to a mixture of 3 parts 2-phenyl-5-ethyl-2-thiazoline and 1 part 2-phenyl-6-methyl-5,6-dihydro-1,3,4-thiazine, when heated with 0.5 equivalent of anhydrous aluminum chloride in nitrobenzene. The mixture was partially separated by fractional distillation. The structures of the hitherto unknown products were proven by unequivocal syntheses. 1-Amino-2-butanol was benzoylated to N-(2-hydroxybutyl)benzamide, which was heated with phosphorus pentasulfide in toluene to give the desired thiazoline. An analogous procedure starting with 4-amino-2-butanol gave the desired thiazine.

N-allylthioacetamide was converted in 48% yield to 2,5-dimethyl-2-thiazoline, b.p. 48°/22 mm., when heated with 0.25 equivalent of anhydrous aluminum chloride. Analogous cyclizations starting with N-(α -methallyl)thioacetamide and N-(β -methallyl)thioacetamide gave 2,4,5-trimethyl-2-thiazoline (46% yield) and 2,5,5-trimethyl-2-thiazoline (46% yield), respectively. Their structures are inferred by analogy.

Cyclization has, in each of the above cases, taken place principally at the carbon atom able to form the more stable carbonium ion. Unreacted starting material was not in general recovered in significant amounts, and the competing side-reactions led to non-basic, therefore presumably non-cyclic, substances. On the basis of this information, an ionic mechanism is proposed.

Microfilm \$2.50; Xerox \$3.00. 57 pages.

CHEMISTRY, PHARMACEUTICAL**STABILITY OF ASPIRIN IN THE PRESENCE
OF AMPHETAMINE SALTS**

(L. C. Card No. Mic 60-2551)

Irwin Lippmann, Ph.D.
University of Michigan, 1960

The objectives of this study were: (a) to determine the effect of amphetamine upon the decomposition of aspirin in buffered solution; (b) to examine the amphetamine effect in saturated solutions of aspirin, these conditions simulating those thought to exist in shelf deterioration; (c) to measure rates of aspirin hydrolysis in solid mixtures with amphetamine salts during exposure to moisture; and (d) to test various means of retarding the reaction.

The first phase of the study was undertaken in order to observe whether amines in general exert a catalytic effect upon the hydrolysis of aspirin. Rates of hydrolysis of aspirin in dilute buffered solutions were determined at 37.0° in the presence of amphetamine, tripeleminamine, and caffeine. Except for a slight acceleration at pH 9.70 with amphetamine, no catalysis was detected.

The next phase of the investigation was concerned with saturated solutions of aspirin. The decomposition of aspirin alone was first studied. Rates of aspirin hydrolysis were determined at 37.0°, 50.0°, 60.1°, and 73.1°. Zero-order kinetics was observed at the two lower temperatures, but at the higher temperatures the rates showed acceleration initially, following zero-order kinetics in the later portion of the reaction. It was demonstrated that at the higher temperatures the solubility of aspirin increased with increases in concentration of its decomposition product, salicylic acid. The quantitative relationship between salicylic acid concentration and aspirin solubility was used to explain the initial acceleration at these higher temperatures.

The rates of hydrolysis of aspirin in saturated solutions containing several concentrations of amphetamine sulfate were determined at 37.0°. All studies demonstrated zero-order kinetics, but the rates were all greater than in the absence of amphetamine and increased with higher concentrations of amphetamine. Aspirin solubility was determined at 37.0° in solutions containing varying concentrations of amphetamine sulfate. The solubility varied with concentration of amphetamine salt and could be expressed as a quadratic function of the salt concentration. A possible explanation of this effect was presented which assumes two reversible reactions between aspirin and amphetamine ion.

The effects of some slightly soluble salts of amphetamine upon the rate of decomposition of aspirin in saturated solutions at 37.0° were also studied. Amphetamine diphenylacetate was an example of such a salt, having a parent acid weaker than aspirin. With this salt, aspirin decomposition proceeded at a high rate initially but decreased with time. The result was explained as the liberation of diphenylacetic acid from the salt by the salicylic acid or aspirin in solution, followed by precipitation of diphenylacetic acid, leaving increased amounts of amphetamine ion in solution. Amphetamine picrate, whose parent acid is stronger than aspirin, was also studied. Here, the aspirin decomposition followed zero-order kinetics with a slight increase in rate. This effect could be

attributed to the increased aspirin concentration which would be expected from the amphetamine ion present, due to the slight solubility of amphetamine picrate.

The final phase of the study was concerned with the decomposition of aspirin crystals in the presence of salts of amphetamine under conditions of elevated temperature and humidity. In mixtures with salts having parent acids weaker than aspirin, the observed rates of decomposition were always greater than in mixtures with amphetamine sulfate. In a stability study at 50° and 89% relative humidity, mixtures containing aspirin with each of several amphetamine salts, all having parent acids that were stronger than aspirin, were evaluated. Increased stability was correlated with increased strength of the parent acid and with decreased salt solubility, the former being the more significant factor.

As a result of this study, it was concluded that investigations in saturated solutions may be useful in making predictions of stability of solid dosage forms.

Microfilm \$2.50; Xerox \$6.60. 136 pages.

CHEMISTRY, PHYSICAL

AN ULTRASENSITIVE MICROCALORIMETER AND THE HEAT OF FORMATION OF Np(III) AND Np(IV)

(L. C. Card No. Mic 60-2186)

Gary Ramsay Argue, Ph.D.
Purdue University, 1960

The thermodynamic properties of neptunium have been neglected in favor of studies on uranium and plutonium which are in greater demand and where the elements are in greater supply. In this study the heats of solution of neptunium metal were measured.

An ultrasensitive microcalorimeter with a sensitivity of $1 \times 10^{-5}^\circ\text{C}$ was built using a thermistor as the sensing element, with automatic recording. The calorimeter was calibrated chemically with the heats of solution of magnesium metal in hydrochloric acid and the heat of solution of potassium chloride in water.

Measurements on neptunium metal were obtained under two sets of conditions:

1. Remeasurement of the heat of solution of neptunium metal to give Np IV indicated that the previous data was in error by about 2%. The value for the heat of formation of Np IV in 1.0 M HCl obtained in the calorimeter was -131.9 Kcal/mole. Correction was made for the presence of fluoride ion.

2. Stabilization of Np III allowed the determination of the first direct measurements of the heat of solution of neptunium metal to give Np III. A reducing agent was used to scavenge the dissolved oxygen in the solution, thus preventing the oxidation of Np III to Np IV. The value for the heat of formation of Np III in 1.0 HCl was -125.6 ± 0.3 Kcal/mole.

3. The data for neptunium in 1.0 M HCl was converted to 0.5 M HClO_4 using data obtained on uranium and plutonium. The heats of formation of the neptunium halides

were recalculated using the measured heats of formation of the neptunium ion.

Microfilm \$2.50; Xerox \$4.80. 91 pages.

A: DIPOLE MOMENT STUDIES OF 1,1- AND 1,2-DIHALOCYCLOHEXANES. B: THE PHOTO ADDITION OF HYDROGEN BROMIDE TO 1-CHLOROCYCLOHEXENE.

(L. C. Card No. Mic 60-2471)

Dervin Leo Flowers, Ph.D.
The University of Wisconsin, 1960

Supervisor: Professor Harlan L. Goering

Part A. Dipole Moment Studies of 1,1- and 1,2-Dihalocyclohexanes

The dipole moments of several 1,1- and *cis* and *trans*-1,2-dihalocyclohexanes have been determined at 25°C. in benzene and carbon tetrachloride solutions. These moments were obtained by measuring the dielectric constant and density of each of the compounds investigated in successively more dilute solutions according to the Hedestrand method.

The individual carbon-halogen bond moments in the three 1,1-dihalocyclohexanes investigated was found to be 2.17 D. The carbon-halogen bond moment for the *cis*-1,2-dihalo compounds was 1.91 D in either solvent. The lowered value of the carbon-halogen bond in the case of the *cis* compounds compared to that of the cyclohexyl halide or the *gem* compounds is considered due to a partial cancellation of the inductive effects of the individual halide in 1,2-dihalocyclohexanes.

The calculated dipole moment for the *trans*-1,2-dihalocyclohexanes depends on the conformation and varies from ~0 for the 1a,2a form to 3.09 D for the 1e,2e structure. The latter value is the moment for the *cis*-1,2-dihalocyclohexanes. Using these limits the mole fraction of *trans* compound in the 1a,2a (and 1e,2e) conformation was calculated for each of the *trans*-1,2-dihalocyclohexanes. From these data, the energy difference ($E_a - E_e$) between the two conformational isomers was found to be 650 cal./mole for *trans*-1,2-dichlorocyclohexane, 370 cal./mole for *trans*-1-chloro-2-bromocyclohexane and -70 cal./mole for *trans*-1,2-dibromocyclohexane (benzene solution).

An increase in size of the halogen atoms in the *trans* dihalide should increase the energy of the 1e,2e structure compared to that of the 1a,2a structure because of steric interactions between the adjacent halogen atoms. This effect is considered the primary cause of the trend in the conformational equilibria observed for benzene solutions of the *trans*-1,2-dihalides. That bond angle distortion due to halogen size is of secondary importance is indicated by the essentially equivalent moments of $2.46 \text{ D} \pm .02 \text{ D}$ for all three 1,1-dihalocyclohexanes.

Part B. The Photo Addition of Hydrogen Bromide to 1-Chlorocyclohexene

The photo addition of hydrogen bromide to 1-chlorocyclohexene in dilute cyclohexane solutions was studied to gain information concerning the mechanism of this free

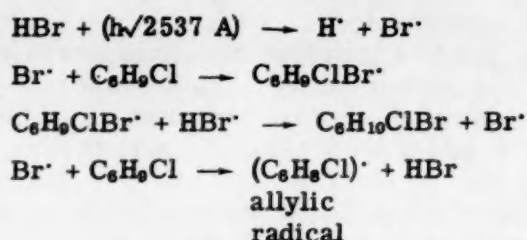
radical chain reaction. Rate measurements were made using dilatometric techniques. The reactions were initiated by illumination of the reaction cell with a Hanovia SC2537 mercury vapor lamp.

The observed reaction rate in degassed solutions appears to be best approximated by

$$-\frac{d(\text{HBr})}{dt} = \frac{d(\text{C}_6\text{H}_{10}\text{ClBr})}{dt} = k'_{\text{exp}} I_0^{0.81} (\text{HBr})$$

The temperature coefficient is negative. The quantum yield for this reaction appears to be about 300 molecules of product formed per quantum of light absorbed. There appears to be a tendency for this value to increase slightly with decreasing incident light intensity.

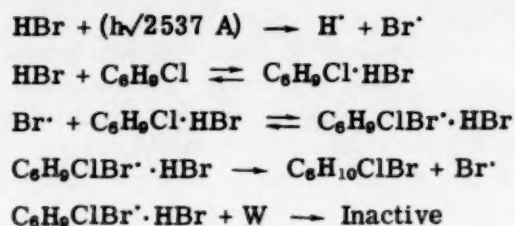
This approximated rate law is consistent with chain termination that is chiefly first order in chain carrying radical species. A reaction sequence of the Kharasch type with allylic termination by bromine atoms reduces to a rate law that is consistent with this approximate rate expression, i.e.,



for which

$$d(\text{C}_6\text{H}_{10}\text{ClBr})/dt = KI_0 (\text{HBr})$$

where K is a reaction constant. A second mechanism also shows a rate law similar to that of the approximated experimental rate law. It involves complex formation between hydrogen bromide and 1-chlorocyclohexene; thus



for which

$$\frac{d(\text{C}_6\text{H}_{10}\text{ClBr})}{dt} = \frac{K'I_0(\text{HBr})}{(\text{W})} = K''I_0(\text{HBr})$$

where K' and K'' are reaction constants. W here is active wall sites or reactive trace impurities whose concentration is not considered to change appreciably but which terminate reaction chains.

The simple Kharasch mechanism with termination by bromine atoms abstracting allylic hydrogen atoms from the substrate appears to be consistent with the present results. Microfilm \$2.50; Xerox \$7.00. 146 pages.

GAS CHROMATOGRAPHY OF HYDROGEN-DEUTERIUM MIXTURES

(L. C. Card No. Mic 60-2496)

Paul Payson Hunt, Ph.D.
The University of Tennessee, 1960

Major Professor: Hilton A. Smith

The feasibility of adsorption columns containing silica gel, Raney nickel, Raney cobalt, charcoal, molecular sieves-5A, and chromia-alumina has been investigated for the separation of hydrogen, deuterium, and hydrogen deuteride by gas-elution chromatography. Complete separation of hydrogen deuteride and deuterium was obtained on the silica gel column with hydrogen as the carrier at 77°K. Partial resolutions of hydrogen and deuterium and of hydrogen, deuterium, and hydrogen deuteride were obtained at -161° with helium as the carrier gas. The peaks were small, and a large sample was necessary in order to produce a sufficient deflection with helium. Neon failed to elute the isotopes from the column at 77°K, and very little separation was obtained at -161°.

Argon was employed as the carrier gas with the Raney cobalt and nickel columns. The retention times obtained on Raney nickel columns were greatly influenced by the size of the sample and the time between runs. Apparently some hydrogen was irreversibly adsorbed on the nickel column. Raney cobalt columns gave different retention times for hydrogen and deuterium passed through the column at the same interval between runs. The sample tailing was considerable, and the overlapping of peaks did not permit the separation of the isotopes.

Helium failed to elute the isotopes from the charcoal and molecular sieve-5A column at -195°. Partial separation of deuterium and hydrogen deuteride was obtained on the charcoal column at -161°.

Complete separation of hydrogen, deuterium, and hydrogen deuteride was obtained on a 12-ft. chromia-alumina column at 77°K. Neon was employed as the carrier gas in a circulatory system. Tailing was very pronounced on the column when it had been activated at 360°. The tailing was reduced, and the sharpness of the peaks was increased by poisoning the column with water and reactivating at 150° for three hours. The chromia catalyzed the interconversion of orthohydrogen and parahydrogen and thus prevented the separation of these species.

An analytical method was developed for determining the composition of the isotopes present in unknown mixtures. Calibration plots were obtained for pure samples of hydrogen and deuterium. Isotopic compositions were determined for equilibrium mixtures. The experimental results agreed very well with the composition calculated from theoretical considerations.

The peaks which were obtained for the isotopes on the chromia-alumina column were completely overlapped at -161°. Further deactivation of the column with water decreased the separation obtained at -195°.

The separation factors obtained on the 12-ft. chromia-alumina column are: $\alpha_{\text{H}_2, \text{HD}} = 1.15$, $\alpha_{\text{H}_2, \text{D}_2} = 1.46$, and $\alpha_{\text{HD}, \text{D}_2} = 1.27$. The values obtained for the number of theoretical plates varied from 1740 for hydrogen to 1150 for hydrogen deuteride. The separation factor determined for deuterium and hydrogen deuteride on the silica gel column was $\alpha_{\text{HD}, \text{D}_2} = 1.16$.

Microfilm \$2.50; Xerox \$5.20. 104 pages.

KINETIC STUDIES AT THE STREAMING MERCURY ELECTRODE

(L. C. Card No. Mic 60-2568)

Richard Arden Slotter, Ph.D.
University of Michigan, 1960

This research was directed toward the accumulation and interpretation of kinetic data for several electrochemical processes using an upward flowing streaming mercury electrode. The initial phase of this problem was to attempt to demonstrate that valid rate parameters could be obtained from direct current measurements at this electrode.

The physical characteristics of this electrode, i.e., the average radius, the average surface velocity and the effective length were determined to within $\pm 2\%$ from measurements of the charging current for .1 M KCl, the mass rate of flow of the mercury, the drop initiation pressure, and the diffusion current for Cd^{++} in .1 M KCl.

The rapid reactions involving the reduction of Cd^{++} , Pb^{++} , and Tl^{+} ions were studied and the results were compared with literature values from similar studies.

Studies were conducted on Eu^{+3} , Eu^{+2} , V^{+3} , V^{+2} , H_3O^{+} using chiefly perchloric acid-perchlorate supporting electrolytes. The results of these studies were presented as evidence for the validity of the method used in this work for interpreting current-voltage curves for slow reactions. The criteria used for evaluating the results were the linearity of the highly irreversible log plots, the internal consistency of the derived rate parameters and comparisons with available literature values.

As further evidence linear log plots were obtained in less extensive studies made on the highly irreversible reduction of a number of ions.

Extensive studies were also made on the reduction of Cr^{+3} and the oxidation of Cr^{+2} . It was shown that for the latter reaction, in the presence of Cl^{-} , there are two competing reactions; one Cl^{-} independent and one Cl^{-} dependent. It was concluded that in the Cl^{-} dependent mechanism the Cr^{+2} and the Cl^{-} ions diffuse independently to the electrode.

Microfilm \$2.50; Xerox \$5.20. 102 pages.

LIGHT SCATTERING INVESTIGATION OF POTATO AMYLOPECTIN

(L. C. Card No. Mic 60-2627)

Lee P. Witnauer, Ph.D.
Temple University, 1953

Extensive light scattering observations were made on potato amylopectin in water solutions and on acetylated amylopectin in several organic solvents.

Potato starch (potassium form) was dispersed with vigorous stirring in water at 90° and the amylose fraction precipitated with pentasol. Amylopectin recovery was 90%. Light scattering was measured in a Brice-Phoenix photometer using a cylindrical cell designed and constructed so that measurements could be made at angles from 135° to 22° , permitting extrapolation to zero scattering angle. Solutions were clarified by centrifugation at 40,000 r.p.m., followed by filtration through ultrafine sintered glass filters and scattering measurements made at concentrations from 10^{-4} to 10^{-6} gm./ml.

Reliable extrapolations to 0° could be made proving the absence of large particles of dust or microgel in the solutions. Three molecular weight determinations averaged 36 million $\pm 10\%$ with values at 436 and 546 $\text{m}\mu$ agreeing to $\pm 5\%$. The 90° scattering was unaffected by temperature in the range 25 to 70° . An amylopectin solution, .5 N in sodium hydroxide, showed less than a 10% decrease in turbidity on heating two hours at 90° if oxygen was absent. An amylopectin solution was heated one hour at 120° in a sealed tube free from oxygen with no appreciable change in turbidity. These results indicate that, if the light scattering particles are aggregates, they are not broken up by heat or alkali.

The amylopectin was fractionated according to molecular size. Nine fractions were obtained by adding ethanol to a water solution of this amylopectin containing 0.1% sodium chloride. The molecular weights of the fractions, which represented 93% of the amylopectin, ranged from 52 to 7 million. One-third had a molecular weight of 48 to 52 million. The weight average for the nine fractions was 36 million. The light scattering radius of the particles ranged from 2030 \AA . to 820 \AA .

Another potato starch (calcium form) was dispersed by autoclaving at pH 6.0 and the amylose removed by complexing with nitrobenzene and absorbing on cotton. The molecular weight of the amylopectin was 14 million and the light scattering radius of the particles was 1090 \AA . Again there was no effect of temperature on the 90° scattering. The difference in the molecular weight of the two amylopectin preparations is attributed to the difference in the original starches or in the fractionation treatments.

A partial acetate (40% acetyl) of autoclaved amylopectin was prepared which was soluble in a number of organic solvents. Turbidity of the acetate dissolved in acetone, chloroform, dioxane, nitromethane and acetonitrile was measured. In all these solvents the molecular weight, corrected for acetyl, was approximately 10 million. There was no abnormality in the scattering at low concentrations to suggest dissociation of molecular aggregates. The refractive index increments of the amylopectin acetate solutions vary directly with refractive index of solvent and is evidence for the validity of the Gladstone-Dale rule as applied to this system. An acetate was deacetylated in .2 N NaOH, the salt dialyzed out and the molecular weight of the water solution determined. A value of 9.4 million was obtained which compares quite favorably with the values obtained for the acetate. The results on the autoclaved amylopectin indicate that the particles are stable to various solvents and only slightly degraded by mild chemical treatment, as in the formation of the partial acetate.

The discrepancy between the high values obtained by light scattering and the low value, ca. 200,000, obtained by osmotic pressure is attributed to the size of the particles. The space available to an amylopectin particle of 16×10^6 molecular weight was calculated for a wide range of concentration. The calculations showed that the particles would not have sufficient space to realize their maximum size in the concentration range employed is osmotic pressure measurements. The solubility of the amylopectin particles would appear to be increasing with decreasing concentration. Therefore the slope of the osmotic pressure plot might be expected to change, from a slight positive one in the high concentration region to a negative one in the low concentration region, as has been observed. However, there appears to

be no justification for extrapolation of such a plot to obtain a molecular weight.

That potato amylopectin is a polyelectrolyte was demonstrated by addition of neutral electrolyte. The light scattering radius of the molecule was reduced from 1010 Å in water to 940 Å in 5×10^{-4} M KCl. At higher concentrations aggregation of the particles occurred as shown by an increase in molecular weight.

The results indicate that native potato amylopectin has a molecular weight of at least 10 million and probably more than 52 million, and that molecules of this magnitude probably exist in the potato starch granules and are not just artifacts created from little "native" molecules under the experimental conditions that have been used.

Microfilm \$2.50; Xerox \$7.40. 156 pages.

ECONOMICS

ECONOMICS, GENERAL

ECONOMIC GROWTH, CAPITAL FORMATION,
AND PUBLIC POLICY IN WEST GERMANY,
1948 TO 1957.

(L. C. Card No. Mic 60-2563)

Karl Wilhelm Roskamp, Ph.D.
University of Michigan, 1960

West Germany's economic growth in the post-war period was an outstanding achievement. In this study we were interested in the special features of this growth. These can be summarized as follows.

The existing productive industrial capacity in 1948, at the time of the currency reform, was larger than is generally believed. Large investments had been made during the war, especially in mining and the basic production goods industries. War losses and dismantling of plants had decreased capacities, but they were still larger than in 1936. Up to 1950 the West German economy grew into existing capacities. Disproportions in the structure of production led to severe bottlenecks. The successful elimination of bottlenecks resulted in substantial increases in production.

A sufficiently high rate of capital formation was the central problem for West German economic growth throughout the period from 1948 to 1957.

The necessity of a high level of capital formation went parallel with a rather low propensity to save.

Government vigorously supported capital formation. It chose to do this through the budget. The necessary savings were obtained through forced savings in the form of high profits, diversion of tax receipts into public investments or government loans to private investors and through tax credits.

Rather low defense expenditures facilitated large government savings. An analysis of the available data showed that public authorities influenced directly or indirectly the bulk of all funds for net capital formation. If we account for both influences, public authorities influenced 57.5% of total net investment from 1949 to 1957.

Direct government investments were not generally made according to immediate profit expectations. Public preferences determined the allocation of loans and subsidies, which were apparently placed in such a way that they furthered an overall increase in production. Bottleneck sectors benefited especially. In cases where tax

exemptions as an incentive to invest were granted to private investors, public and private preferences influenced the investment decision. Private long-run profits could be maximized only if attention was paid to public policy.

The strong public influence on capital formation guaranteed a continued high level of investment and tended to make the investment structure more balanced.

Up to 1955 the rather tight monetary policy which was pursued tended to re-enforce fiscal policy measures geared to favor capital formation. It forced business to look for tax relief if it wished to obtain or retain necessary funds for investments. General monetary policy measures had for structural reasons no, or insignificant, repercussions on the capital market up to 1955. Since that year a broader but little resilient capital-market, in which institutional investors supply the bulk of investible funds, was found to be affected through restrictive general monetary policy measures.

It could be argued that the same public influence on capital formation as exerted through fiscal measures could have been achieved through an easy monetary policy. In this case the volume of investment might have been the same but the structure would have been different as, unlike through government loans and tax credits, it would have been impossible to influence the direction of investments through general monetary policy.

The way in which the West German capital formation was financed caused severe inequities. It facilitated the accumulation of capital in higher income brackets. High profit incentives which were created by public authorities overwhelmingly benefited higher income brackets. For lower income brackets tax incentives often had little or no interest. It is now admitted by West German officials that low- and medium-income brackets could accumulate scarcely any capital in the years of tremendous economic growth and expansion. It seems that regressive consequences could not be avoided in the vigorous effort to have rapid economic growth.

Microfilm \$5.80; Xerox \$20.50. 455 pages.

ECONOMICS, COMMERCE - BUSINESS

THE EFFECTIVENESS OF LIFO INVENTORY
IN THE TEXTILE INDUSTRY

(L. C. Card No. Mic 60-2515)

John Elmer Champion, Ph.D.
University of Michigan, 1960

Although much has been written on the theoretical principles and advantages and disadvantages involved in the application of the last-in, first-out inventory method, little attention has been given in the literature to the study of actual cases. The purpose of this thesis is to study how LIFO has affected the operating results of four cotton textile concerns over a term of years and to determine whether actual results have fulfilled the theoretical claims. The textile industry was chosen because its companies were among the first to adopt the LIFO method.

The first part of the study is devoted to the history of the development of LIFO, an illustration of the mechanics of the LIFO method used by the companies in this study, and a summary of the major advantages and disadvantages of LIFO stated by authors in accounting and business literature. A check list of questions which have been raised in accounting literature was prepared.

Individual case studies comprise the second part of the thesis. Inventory figures, both in quantities and dollar valuations, were obtained from the date that the companies studied adopted LIFO until 1956. The operating results of the companies were then compared under LIFO and FIFO through the use of tables and graphs. The check list was applied to each company in an attempt to answer the questions through the use of data of the companies examined.

The results of the case studies left little doubt that every company enjoyed an income tax advantage in the first year that LIFO was adopted, because profits calculated under LIFO were considerably less than those calculated under FIFO. This resulted from a substantial increase in the price of the principal item of inventory during the year of adoption. This factor seemed to overshadow any of the theoretical advantages which the use of LIFO offered. There was strong evidence that there was a close matching of costs and revenues and an elimination of calculated inventory profits in the first year under LIFO. Whether this was true for all succeeding years was not so clear since there was no major difference in the movement of the revenue and cost curves under FIFO and LIFO.

The LIFO method showed somewhat less fluctuation in calculated income over a period of years than FIFO. The claim that LIFO results in the elimination of illusory profits tended to be true in those years when prices were rising and inventory was increasing. It was not true in those years where there were sizable liquidations of inventories. The inventory figures resulting from the use of LIFO on the statements of financial position bore no relationship whatsoever to replacement costs at the time statements were prepared. There was strong evidence to refute the argument that a fixed amount of inventory was necessary for the companies to carry on operations. Inventory quantities fluctuated over the years studied, and the amount of inventory on hand seemed to have had no direct relationship to the amount of sales. One of the most important conclusions resulting from the study was that one cannot answer whether LIFO was effective for the

cases studied by an unqualified positive or negative answer. However, there was enough evidence in most instances to draw the tentative conclusions.

Microfilm \$2.95; Xerox \$10.35. 226 pages.

ECONOMICS, FINANCE

THE EFFECT OF THE CORPORATION INCOME TAX
ON STOCKHOLDERS

(L. C. Card No. Mic 60-2511)

Peter Charles Briant, Ph.D.
University of Michigan, 1960

The purpose of this study is to determine whether the corporation income tax is paid by stockholders. This is an important theoretical and practical question because many critics and proponents of the tax base their case on the assumption that it is not shifted. It is of particular importance now that the tax rate is 52 percent.

From Statistics of Income, rates of return on common share capital, net income per dollar of revenue, and capital turnover have been computed for all corporations filing tax returns with balance sheets attached for the years 1926-1955. Calculations are based on historic dollars for the whole period, and also on current dollars from 1935-1955. The behaviour of these indices is observed and the results used to sustain or contradict various hypotheses as to incidence previously deduced. An inverse relationship between annual changes in the effective tax rate and rates of return evidences that the tax is not shifted in the short-run. However, the over-all stability of the after-tax yield on stock equity leads to the conclusion that long-run shifting has occurred. Between 1926 and 1929, the rate of return on common share capital averaged 6.24 percent a year; between 1950 and 1955, when tax rates were 40 percentage points higher than in the earlier period, the rate of return, even after adjusting for inflation, averaged 6 percent a year. By 1955, after-tax margins in current dollars had been reduced to half the rate during 1926-1929. The effect of the tax on the return to common stockholders and on corporate investment thus appears to have been mitigated by an independent increase in capital turnover which cannot be related causally to the tax.

Tax effects on capital structure and dividend policies are also examined since the tax is said to encourage debt financing and the retention of earnings. Data on new security issues from 1926-1955 are presented. The elements in capital structure are expressed as a percentage of net assets employed, and cash dividends as a percentage of net income. Both series are based on historic dollars from 1936-1955, and also on current dollars from 1935-1955. Also computed are the sources of corporate funds between 1936 and 1955. The results indicate that the corporation income tax has had no discernible effect on the aggregate corporate capital structure. While the proportion of total debt to net assets rose during the period, the proportion of interest-bearing debt declined from 15.95 percent of net assets in 1926 to 14.11 percent in 1955. Similarly, cash dividends as a percentage of net income

appear, on a current dollar basis, to have remained relatively stable over the period and unaffected by the tax. These findings reflect the importance of factors other than the income tax on corporate financial policies. They also provide further evidence that the fortuitous increase in capital turnover, associated with the steady flow of inventions and innovations since 1941, has played the crucial role in moderating the effect of the tax on yields and on corporate investment.

Three general conclusions are drawn from this study:

- 1) Even though the corporation income tax does not appear to be paid by stockholders, it is incompatible with the requirements of economic growth since the shifting is achieved by restricting corporate investment.
- 2) Because of its direct influence on corporate investment, the tax contributes to inflationary pressures in the economy.
- 3) By striking directly at investment decisions, the tax does not leave the private sector of the economy free to choose between restricting consumption or investment expenditures to meet this part of its tax burden.

Microfilm \$2.50; Xerox \$8.00. 173 pages.

ECONOMICS, THEORY

FAMILY COMPOSITION AND CONSUMPTION

(L. C. Card No. Mic 60-2524)

Martin Heidenhain David, Ph.D.
University of Michigan, 1960

Each family consumes according to the needs and tastes of its members. As both needs and tastes vary with age, the goods consumed by the family reflect its changing composition. In this study relationships between family composition and the consumption of large household durables, housing, and automobiles are explored. Some theory is developed to integrate the observed effects and classical models of consumer behavior which ignore family composition (e.g., the theory of consumer behavior developed by Pareto and summarized by J. R. Hicks in *Value and Capital*).

The empirical results presented are obtained from analysis of cross section data collected in the 1955, 1956, and 1957 Surveys of Consumer Finances. These data suggest that the large family economizes by making more use

of washing machines, dryers, and deep freezers than the typical small family (Chapter 4). The data demonstrate that increasing family size is associated with consumption of poorer quality housing. The families whose head is young live in more crowded quarters than families with older heads. Renters with large families benefit by renting large houses at a cost less than proportional to the cost of small properties (Chapter 5). The data indicate that consumption of automobiles is determined not only by family size but also by the age of the family head and his marital status (Chapter 6).

The empirical findings support the following four hypotheses which are developed in the theoretical argument of Chapters 2 and 3:

- (1) The age, marital status, and size of the consumer unit must be studied simultaneously if we are to understand how variation in any one dimension affects consumer preferences.
- (2) Increasing family size is associated with purchase of commodities at quantity rates.
- (3) Increasing family size is associated with a shift from the purchase of commercially produced services to the production of these services in the home.
- (4) Increasing family size is associated with an increase in the consumption of lower quality goods.

A variety of techniques were used to analyze the data. The contribution of dimensions of family composition to an explanation of consumption of durables was evaluated by study of the correlation ratio and the intra-class correlation, ρ , calculated from tabulations of the dependent variable against various family characteristics. Consumption of housing was studied by separate analyses of the quantity of housing consumed and its price per room. Following preliminary tabulations to assure linearity and to detect interactions in the effect of disposable family income and family size on the dependent variable, the effect of family size was summarized by estimating suitable regressions. The effect of the age of children, the age of the family head, and the number of children on consumption of housing was then studied by analysis of the residuals in each regression. Consumption of automobiles was assumed to be proportional to the value of the automobile; the effects of family size, income, age of the family head, and number of children in the family on consumption of automobiles were studied by covariance analysis.

Microfilm \$2.50; Xerox \$6.80. 143 pages.

EDUCATION

EDUCATION, GENERAL

A COMPARATIVE STUDY OF THE SUGGESTIBILITY CHARACTERISTICS OF RETARDED CHILDREN IN REGULAR CLASSES AND RETARDED CHILDREN IN SPECIAL CLASSES

(L. C. Card No. Mic 60-2599)

Leon Charney, Ph.D.
Syracuse University, 1959

The purpose of this study was to compare the conformity characteristics of retarded children in regular classes to the conformity characteristics of retarded children who had spent 2 or more years in special classes for the mentally retarded.

An experimental situation was devised in which each group was subjected to pressure from 4 other classmates to deny perception of abstract and verbal stimuli. Each subject had previously been measured in reference to their ability to accurately perceive these stimuli.

Increments in errors were observed and interpreted as the result of pressure to conform. When conformity to the total series of stimuli were compared between the two groups, no differences were found. Differences were found, however, in the degree to which the groups yielded in reference to the verbal stimuli.

It is suggested that differential reactions are in part a function of the ability of the stimuli to elicit transfer reactions based upon previous experience.

The results suggest that differences exist between these two groups of children in the degree to which they conform when the stimuli are capable of eliciting such transfer.

Microfilm \$2.50; Xerox \$5.40. 107 pages.

THE TRANSFER STUDENT IN THE COLLEGE OF LIBERAL ARTS (A TEN-YEAR COMPARATIVE STUDY OF 1,553 FOUR-YEAR INSTITUTION AND 385 JUNIOR COLLEGE TRANSFER STUDENTS IN THE COLLEGE OF LIBERAL ARTS AT SYRACUSE UNIVERSITY: 1946-1955).

(L. C. Card No. Mic 60-2604)

Charles Henry Holmes, D.S.S.
Syracuse University, 1960

Transfer students from the four-year institution and junior college are becoming more numerous today than ever before, and this group will continue to expand in the future. In order to keep abreast and perhaps ahead of this increase, a study has been here instituted at the request of Dean Eric H. Faigle, Dean of the College of Liberal Arts at Syracuse University, to evaluate the relative merits or demerits of the four-year and junior college transfer in the College of Liberal Arts.

The primary questions evaluated in this study are as follows: Are significant differences apparent in the performance of transfer students as compared with non-transfer students? Does the transfer student meet the standards set up by the College of Liberal Arts in terms of academic preparation prior to transfer, in grade point averages at the prior institution and at Syracuse, in scholarship, honors, and graduation? In terms of the findings, should the College enroll transfer students in greater numbers or continue to draw graduates primarily from the high schools?

This study reviewed 1,553 transfer students from four-year colleges and universities, and 385 junior college students who transferred to the College of Liberal Arts from 1946 to 1955. The four-year institution transfers were the first group studied and were compared where possible to the native student; i.e., a student who has always matriculated at Syracuse. The junior college transfer group was then reviewed in comparison with the four-year transfer and, at times, the native student.

The findings show, among other things, that four-year transfers to the College of Liberal Arts come primarily from New York State institutions, whereas the junior college transfer comes primarily from schools that are out of state. The largest percentage of the four-year transfers come from the smallest four-year institutions whereas the junior college transfers generally come from the largest junior colleges.

Four-year transfers to Syracuse had more preparation in high school and prior work in higher education than the junior college transfers. In terms of grade point averages at the prior institution and at Syracuse, the four-year student showed a slight drop while at Syracuse but remained slightly above the native student; the junior college transfer, on the other hand, showed a somewhat sharper decline. The probationary and "drop" statistics were highest for junior college transfers and lowest for the native student. The opposite held true of honors accorded at graduation where the native student was highest, followed by the four-year transfer and then the junior college transfer. Both the four-year and junior college transfers graduated approximately two-thirds of their entering groups.

"Majors," or those areas of study in which the student finally concentrated, at Syracuse were proportionately equivalent for both transfer groups and the native student. The curriculum background of the junior college transfer at the prior institution has been found equivalent to that of the native student both in terms of individual course titles and general education requirements.

This study, in its final analysis, cannot support an increase in junior college transfers to Syracuse. For those who are accepted, a careful evaluation must be made of the institution from which the student transferred as well as the transfer student himself. This is not meant to be an indictment of the junior college system. The author personally feels that much of our long-range educational salvation lies in an enlarged, coordinated junior college

network, yet the empirical evidence shows a less successful transition for the junior college transfer than for the four-year transfer at Syracuse University.

Microfilm \$2.80; Xerox \$5.80. 216 pages.

AN EVALUATION OF ATTITUDINAL OUTCOMES
OF FIFTH AND SIXTH GRADE STUDENTS
FOLLOWING A PERIOD OF SCHOOL CAMPING

(L. C. Card No. Mic 60-2638)

Genevieve Carter Stack, Ph.D.
The University of Oklahoma, 1960

Major Professor: Dr. Gail Shannon

This study concerned itself with attitudes toward the selected concepts of classmates, school, teacher, school camping, self, and friends possessed by fifth- and sixth-grade students prior and subsequent to a period of school camping. Data were secured from 44 boys and 44 girls from a lower-middle socio-economic background who engaged in one week of camping at Clear Lake Camp, Dowling, Michigan.

Findings:

Ninety per cent of the students made new postcamp sociometric choices with a group mean of 1.61 new choices being made. Sixth-grade students made more new sociometric choices, as well as more choices of the opposite sex, than did fifth-grade students. Boys formed more friendships during camp than did girls.

Girls tended to regard school more positively than boys; following camp, boys changed positively to a small degree in their attitudes toward school. There was an over-all change to a more positive attitude toward school camping, subsequent to the experience, with boys reacting more positively to the concept than girls.

Attitudes toward the ego-concept failed to show a gain following camping; sixth-grade students tended to place more value on relationships and associations rather than on the self.

The three most favorable precamp attitudes were in rank order those concerned with classmates, self, and school camping; whereas the three most favorable postcamp attitudes were in rank order those relating to friends, self, and classmates.

Conclusions:

1. Greater freedom of choice of companions and new friendships formed characterized the school-camping program, despite its limited duration.

2. School camping provided unique opportunities for effecting social change, particularly in relationship to racial cleavage.

3. Although classmates of lowest sociometric rating received more recognition from classmates following camping, no appreciable improvement in the sociometric work-companion ratings of neglectees and isolates was effected.

4. Students regarded school more positively after

camp, with widened friendship patterns exerting an influence for an improved emotional tone in the classroom.

5. The curriculum innovation of school camping through its democratic atmosphere proved to be an important factor in strengthening rapport between teachers and students.

6. Students keenly anticipated the school-camping program, with boys reacting more favorably than girls, subsequent to the experience.

7. Educational camping, by its structure, increased the values of relationships and associations over those of the ego-concept.

8. For boys, particularly, school camping served as a new stimulus to rekindle interests regarding school, teacher, camping, self, and friends.

Recommendations:

1. Further study should be made for provision of more common experiences for students, such as camping.

2. Additional investigation should be undertaken to determine the value of sociometric information in identifying desirable and productive student relationships.

3. The contributions of camping should be determined for the middle elementary grades and junior high school.

4. Ways and means of integrating camp and classroom experiences should be explored.

Microfilm \$2.50; Xerox \$7.00. 149 pages.

THE MATHEMATICS PROGRAM OF THE
SOVIET SECONDARY SCHOOL:
ITS STATUS AND INNOVATIONS.

(L. C. Card No. Mic 60-2581)

Bruce Ramon Vogeli, Ph.D.
University of Michigan, 1960

The purpose of the study is to provide detailed and adequately documented data concerning the mathematics curricula of grades V, VI, VII, VIII, IX, and X of the Soviet ten-year school. Three specific questions are of primary concern:

1. What is the current nature and status of the mathematics program of the Soviet secondary school?
2. What "trends," if any, are discernible in recent Soviet curricular revisions in the area of mathematics?
3. What relation do these trends bear to Soviet educational policy as stated in Soviet publications in the area of mathematics education?

Question 1 is attacked in three stages. The first stage consists of an analysis of the official syllabus in arithmetic and standard arithmetic texts. Its purpose is to determine the objectives of instruction in arithmetic in grades I, II, III, and IV of the Soviet ten-year school. The principal instructional aims at this level are found to be: (1) to teach children to carry out operations with whole numbers correctly, meaningfully, confidently, and rationally, and (2) to teach them to apply the knowledge and skills learned

to the solution of arithmetic problems and the performance of simple calculation.

The second stage, a detailed analysis and collation of the official syllabus in mathematics, standard mathematics texts, and standard collections of problems, is designed to gauge the tempo and depth of instruction in mathematics in the Soviet secondary school. Topical analyses of curricula in all mathematical disciplines are part of the thesis.

Analyses of the graduation examinations in algebra and geometry comprise stage 3. The purpose here is to determine the level of achievement expected of secondary school graduates. In general, examinations appear to require formal knowledge of selected curricular topics.

Question 2 is answered by comparing the current program in mathematics with that for the academic year 1952-53. This comparison is made by collating the syllabus, texts, and problem collections for 1958-59 with those for 1952-53. Revisions enacted appear to determine or to be determined by three interrelated factors or trends: (1) polytechnism, (2) the desire to lighten the pupil's academic load, and (3) efforts to raise the scientific level of instruction in mathematics.

Question 3 is resolved by analyzing articles appearing in selected Soviet professional journals. This analysis indicates that the trend toward polytechnism is in complete agreement with Soviet educational directives of the period. Efforts to lighten the pupil's academic load seem attributable to principles of health or public relations, while increases in the scientific level of instruction cannot be tied to specific Communist Party or governmental policies. Microfilm \$7.05; Xerox \$25.20. 556 pages.

EDUCATION, ADMINISTRATION

AN ANALYSIS OF THE STRUCTURAL FEATURES OF NEW SCHOOL PLANTS AND THEIR RELATIONSHIP TO THE FIRE INSURANCE PROGRAM OF SELECTED SCHOOL DISTRICTS

(L. C. Card No. Mic 60-2598)

Bradley A. Bishop, D.S.S.
Syracuse University, 1960

The Problem

It was the purpose of this study to analyze the structural features of new school plants and their relationship to the fire insurance program in selected school districts.

Significance of the Study

The administration of a public school district is a complex of tasks. One of the major tasks of the administrator is the responsibility for guiding the Board of Education in its decisions in the construction of new school buildings. Another task is the exercising of the wisest possible judgment in the expenditure of the funds of the district as related to the protection from loss of this property. Fire insurance accounts for the major portion of the costs for public school property loss protection and is considered one of the hidden costs of construction.

Several studies have been made of insurance practices and the elimination of fire hazards in completed buildings. This study was an attempt to discover those structural features incorporated in new school buildings which affected the fire insurance costs. A consideration of these findings by school administrators planning new school plants would provide another method of reducing the overall costs of new construction.

Summary of Procedures

The thirty-eight new school plants and the fire insurance procedures of fifteen of seventeen central school districts of Chautauqua County in New York State were investigated by the case study method.

A checklist, developed from the Rating Schedule of the New York Fire Insurance Rating Organization, was designed to discover the structural features affecting the fire rate in the school plants. A questionnaire to discover current fire insurance procedures and practices was developed from a study of the literature. Personal interviews with officials of the school districts and the rating organization provided further information and clarification of the responses to the instruments.

The data were reported in terms of frequency of occurrence for the population, for the building classifications, and by a case study of the individual school districts.

The Findings

The data presented throughout this study were interpreted by the writer to have the following implications for educational administrators concerned with the development and efficient operation of school plants.

Many economies in school fire insurance programs are possible through a consideration of the structural features in the planning stage of new school plants.

School districts fail to assume enough responsibility for the specific structural features in the planning stage of new school plants.

There is a need for school officials to establish a closer working relationship with the architects during the planning stage of new school plants.

School districts do not take full advantage of the advisory services offered by fire insurance rating organizations during the planning stage or the life of school plants.

Seemingly minor conveniences of operation or the appearance of new school plants are given preference over fire safety.

There is a tendency to underestimate the fire hazard inherent in one story school plants.

Elementary school buildings tend to be of more hazardous construction than secondary school buildings.

There is a tendency to neglect or underestimate the need for protection from fire in the service buildings of school districts.

The structural features of additions to existing school plants tend to follow the pattern of structural features incorporated in the original structure.

There are opportunities for economies in the fire insurance program of school districts particularly in the areas of appraisal and evaluation.

School districts tend to rely heavily on the advice of insurance agents in the administrative practices of a technical nature.

There is an acceptance by school districts of inefficient

administrative practices which are not immediately apparent as affecting the cost of the fire insurance program.

School districts tend to adopt efficient administrative practices which are readily apparent in the costs of the fire insurance program.

Microfilm \$2.70; Xerox \$9.25. 205 pages.

**A PROPOSED PROGRAM OF ACCOUNTING
FOR THE EXTRACURRICULAR ACTIVITY
FUNDS IN THE PUBLIC SECONDARY
SCHOOLS OF OKLAHOMA**

(L. C. Card No. Mic 60-2632)

Richard Brown Burch, Ed.D.
The University of Oklahoma, 1960

Major Professor: Claude Kelley

The extracurricular activities have been in our schools for some time. The accounting for the extracurricular activity funds is a problem that all school administrators must deal with. It is the purpose of this study to analyze the various practices in the several states and in the public secondary schools of Oklahoma, and to propose a program of accounting for the extracurricular activity funds, that will be uniform in all the schools of the state. Three hundred fifty schools out of the 602 public secondary schools responded to the questionnaire. Forty-nine out of the 50 State Departments of Education responded to the letter pertaining to accounting for extracurricular activity funds in the various states.

Summary of Findings:

Twenty-two of the states reported that they do not have any plan of accounting for the extracurricular activity funds; the individual schools may account for these funds in any manner they choose.

Fifteen of the states reported that their extracurricular activity funds are regulated by specific legislation; the statutes in these states define student activity funds as money raised with the approval of the board of education by the students for their use in connection with the activities of the student body. The states with statutory provisions provide for a legally approved depository and an annual audit.

Twelve of the states reported that the accounting for their extracurricular activity funds was regulated by policies of the state department of education. The system of accounting in these states is essentially the same as those described with statutory provisions. The difference is that states with policies recommend a uniform system of records, and they provide for more detailed provisions for records and record forms than the states with statutory provisions.

The questionnaire revealed that the public secondary schools of Oklahoma did not follow the basic principles found in the literature in accounting for their extracurricular activity funds.

The accounting forms proposed in this study are the minimum recommended by the authorities and the various states in accounting for extracurricular activity funds.

Major Conclusions:

1. Since the public schools of Oklahoma can now account for their extracurricular activity funds in any way they choose, it is concluded that there is need for establishment of a definite system of accounting for these funds in the schools of the state.

2. The total amount of money expended is in excess of nine million dollars. More people need to realize this and become concerned about the accurate accounting of the funds.

A major recommendation was that the legislature of the state of Oklahoma should enact statutes directing the state department of education to assume the responsibility for the supervision and accounting of the extracurricular activity funds.

Microfilm \$2.90; Xerox \$10.15. 222 pages.

**AN APPRAISAL OF THE FUNCTIONS OF
ELECTED LAY COUNTY BOARDS OF
EDUCATION IN CALIFORNIA**

(L. C. Card No. Mic 60-2479)

Richard Miller Clowes, Ed.D.
University of Southern California, 1960

Chairman: Professor Nelson

The purpose of this study was to analyze and evaluate the work of the elected, lay county board of education in California through examination of the minutes of board meetings and by study of reactions of county superintendents of schools and presidents of county boards of education to various aspects of the operation of the county board. Answers to the following questions were sought: (1) What problems exist in connection with the operation of an elected, lay county board of education? (2) What values result from the existence of an elected, lay county board of education? (3) What changes in the present system are proposed by county superintendents of schools and by presidents of county boards of education?

Examination was made of all of the available literature. The minutes of the meetings of thirty-two California county boards of education for the year 1956-57 were read, and twenty of the sets were tabulated completely to determine what actions had been performed most frequently by county boards of education. A questionnaire was sent to all presidents of county boards of education, and to all county superintendents of schools, with the exception of San Francisco County.

Findings. (1) The subjects most frequently acted upon by county boards of education relate to the following: credentials, adoption of textbooks, elementary school diplomas, interdistrict attendance disputes, filling of vacancies on school boards, and adoption of audio-visual aids. (2) County board presidents and county superintendents do not generally favor discontinuing the performance of any of the functions now being performed by county boards of education. (3) Much of the work of the county board of education is routine in nature. (4) Board presidents and county superintendents believe that positive values result from the existence of the county board, but

that certain problems either are created by it or limit its effectiveness. (5) County superintendents and county board presidents generally favor the appointment of the county superintendent by the county board. (6) A majority of the county superintendents would not again establish a county board of education in its present form, but a majority of county board presidents would establish a county board of education, if given an opportunity to reorganize the system of public education in California. (7) There is little or no indication that any important policy development is carried out by county boards of education.

Conclusions. (1) Apparent dualism exists in the authority of the county board of education and of the county superintendent of schools. This dualism results from the fact that both are elected and from the fact that the Education Code specifies that many functions are to be performed by the county superintendent with the approval of the county board of education. (2) The chief value of the county board lies in its effectiveness as a "sounding board," or as an instrument for public relations. (3) There needs to be a change in the relationship of the county board to the county superintendent. (4) Some of the routine, relatively minor functions of the county board of education should be eliminated from its sphere of responsibility.

Recommendations. (1) The county superintendent of schools should be appointed by the county board of education. (2) Many sections of the Education Code should be revised to establish clearly the respective roles of the county board of education and the county superintendent of schools. (3) Certain of the present functions of the county board should be eliminated, including awarding eighth-grade diplomas, approving temporary teaching certificates, and approving life-diploma applications. (4) The fact should be clarified by legislative action that a county board of education member may not concurrently serve on a local school district board of trustees. (5) County boards of education should adopt carefully developed policies to govern their operation. (6) Steps should be taken to eliminate the county board's responsibility to the county board of supervisors. (7) Study should be given to the possibility of combining sparsely populated counties into one intermediate unit to replace existing separate units. (8) Legislation should be adopted which clearly states the relationship of the intermediate unit to the State Department of Education. If the intermediate unit is to be an arm of the state, this fact should be understood by all, and the responsibilities entailed should be defined.

Microfilm \$3.75; Xerox \$13.05. 289 pages.

A STUDY OF CERTAIN FACTORS RELATED TO IN-SERVICE EDUCATION IN SELECTED SCHOOL DISTRICTS IN NEW YORK STATE

(L. C. Card No. Mic 60-2603)

Carl Winter Hassel, Ed.D.
Syracuse University, 1960

The Problem and Method

The problem is to ascertain current patterns in use for organizing, planning, conducting and evaluating programs of in-service education in selected schools in New York

State. Part I of the study reports data on in-service education programs in 1956-58 in thirty-three selected school systems. Part II of the study consists of more extensive reports of in-service education in four schools selected from the larger sample. Data for Part I were collected by means of a questionnaire responded to by chief school administrators. Data for Part II were collected by means of teacher questionnaires and personal interviews with administrators, carried on during the course of a two day visit by the investigator in each of the four sub-sample schools.

The following data are reported in Part I and more extensively in Part II:

1. Number and variety of in-service projects
2. Types of problems under study
3. Extent of staff participation
4. Patterns of organization
5. Patterns for planning
6. Patterns for obtaining staff participation
7. Resource persons used
8. Financial support available
9. Evaluative techniques in use
10. Specific changes related to in-service programs

In addition to a more comprehensive investigation of areas outlined above, additional areas reported in Part II are:

1. General attitudes of teachers and administrators toward in-service education
2. The degree to which schools utilized selected guidelines for successful in-service education as perceived by teachers and administrators
3. Reactions of teachers to values of specific in-service projects in their schools
4. Specific problems related to in-service education
5. Needed improvements in in-service education, as reported by teachers and administrators
6. The most and least successful in-service projects as reported by teachers, with determination of factors present which cause projects to be so rated

Findings and Conclusions

Major conclusions relating to Part I, the survey study of in-service education in thirty-three selected schools, are as follows:

1. There was evidence of the presence of in-service education in each school system.
2. Although there was wide variation from school to school in the conduct of in-service education, certain common patterns emerged.
 - a. Planning is carried on primarily by administrative personnel.

- b. Building faculty meetings are the most used technique for in-service education.
 - c. Projects related to improvement of methods of instruction were reported most often.
 - d. Membership in projects derived most frequently from administrative appointment.
 - e. Use of school staff members as resource persons is most common.
 - f. Evaluation techniques, when used, are largely subjective, concerned primarily with participants' attitudes rather than outcomes related to educational objectives.
 - g. Changes brought about appear to be largely in terms of improved methods and materials of instruction, rather than in teacher attitudes or philosophy.
3. The level of financial support of in-service education in respondent schools was low, with a median of .33 per cent of current expenses designated for in-service education.

Through extensive case studies of in-service education in four sub-sample schools, the following conclusions are reported:

- 1. In-service education is viewed as a process for professional growth.
- 2. General objectives for in-service education are similar from school to school.
- 3. There is recognition that in-service activities need careful planning.
- 4. Planning is a cooperative process.
- 5. There is recognition that problems emerge from many sources.
- 6. The building principal is the primary leader in in-service education.
- 7. A wide variety of common practices is in use.
- 8. A variety of resources is available and used.
- 9. Evaluation is largely subjective.
- 10. Attitudes toward in-service education vary:
 - a. Elementary teachers are more enthusiastic than secondary
 - b. Teachers are more enthusiastic than unenthusiastic.
 - c. Principals rated teachers as being more enthusiastic than teachers rated themselves.
- 11. Responses by teachers to guidelines for successful in-service education showed the following:
 - a. Teachers rated programs of in-service education less favorably than administrators.
 - b. Teachers appeared to feel that improvements were needed in the following areas:
 - (1) Teacher-administrator relationships.
 - (2) Time available for in-service education.

- (3) Nature of inter-personal relations.
- (4) The psychological setting.
- (5) Problem solving techniques.
- (6) Translating committee recommendations into action.
- (7) Evaluation and appraisal techniques.
- (8) Inter-group relationships.
- (9) Recognition of individual differences in teachers.

12. In addition to improvements listed above, most commonly reported suggestions for changes made by teacher respondents were as follows:

- a. The number of in-service meetings should be reduced.
- b. Content and organization should emerge from the faculty and be related to needs of the faculty.
- c. Improved coordination of in-service activities is needed.

13. Characteristics of successful in-service projects are identified as follows:

- a. Participants in successful projects participate in planning those projects.
- b. Problem identification procedures are well defined and tend to utilize research techniques.
- c. Outcomes are clearly defined and are clearly identified by participants.
- d. Personal changes made by participants can be identified, with changes in attitudes often reported.
- e. Projects which satisfy personal needs of participants are rated as most successful.

Microfilm \$4.70; Xerox \$16.65. 366 pages.

A STUDY OF THE ROLE OF THE SCHOOL PRINCIPAL IN INSTRUCTIONAL IMPROVEMENT IN THE SCHOOLS OF DALE COUNTY, ALABAMA.

(L. C. Card No. Mic 60-2650)

Lathem N. Sibert, Ed.D.
Auburn University, 1960

Supervisor: Truman M. Pierce

THE PROBLEM

This study was concerned with the role of the school principal in instructional improvement in the schools of Dale County, Alabama. The primary purpose was to appraise the role of the school principal in instructional improvement and set forth next steps to serve as one resource for the school principal in the instructional program.

Five steps were used to achieve this purpose. They were:

- 1. To identify certain principles relative to the role of

the school principal which appeared to facilitate instructional improvement in elementary and secondary schools.

2. To formulate criteria which could be used as a basis for appraising the role of the school principal found to exist in the schools included in this study.

3. To analyze in terms of these principles the present role of the school principal in instructional improvement in the selected schools.

4. To appraise, on the basis of established criteria, the role of the school principal in instructional improvement in the selected schools.

5. To summarize the findings and project, on the basis of the evaluation, next steps for the principal in instructional improvement for the schools of Dale County, Alabama.

PROCEDURE

Four research techniques were used to secure the information considered necessary to achieve the purposes of this study. (1) Interviews with principals, teachers, and students in their own schools and classrooms constituted the primary method of investigation. (2) Questionnaires were used to secure data from principals and teachers. (3) Observation in classrooms, faculty meetings, principal's meetings, and parent-teacher meetings were made. (4) Recorded diaries by principals of their activities over a twenty-day period of time were used. Pilot surveys were made before the study was initiated to determine the adequacy of the questionnaire and interview guide.

FINDINGS

1. Principal performance in the major task areas of instructional improvement identified and developed in this study was limited.

2. Principals allocated a major portion of their time to tasks not directly related to instructional improvement.

3. Principals and teachers were not satisfied with their efforts to improve instruction.

4. Teachers desired assistance from the school principal in improving the quality of their work.

5. Teachers did not perceive the school principal as instructional leader due to the many other duties he assumed.

6. A majority of teachers felt that the principal based his decisions on facts when dealing with teacher problems.

7. Teachers felt that they were permitted freedom to plan, implement, and evaluate their work.

8. Principals took a personal interest in problems of the teacher on and off the job.

9. Principals took action when, in their opinion, the teacher was not doing a good job.

10. Teachers felt that principals were usually accessible, easy to talk to about most things, and took prompt action on teacher problems.

11. Principals and teachers evaluated the teaching effectiveness of their own faculty group as better than most other faculty groups in the county.

12. A majority of the principals, teachers, and students felt they were accepted as well as other members of the group.

13. Students rated the quality of learning experiences provided by the school as superior.

SUGGESTED NEXT STEPS

1. The local school unit should serve as the basic unit for instructional improvement.

2. The key role in the program of instructional improvement should be assumed by the local school principal.

3. Principals should allocate more of their time to tasks directly related to instructional improvement.

4. An improved working relationship should be established within the total staff.

5. Principals should provide better opportunities for those concerned with instructional improvement to formulate curriculum objectives.

6. Principals should provide better opportunities for those concerned with instructional improvement to determine curriculum content.

7. Principals should provide better opportunities for in-service education of those concerned with instructional improvement.

8. Principals should provide more opportunities for the staff members to utilize community resources.

9. Principals should make provision for the supervision of the instructional program.

10. Principals should provide opportunities for the selection and utilization of instructional materials.

Microfilm \$3.60; Xerox \$12.60. 280 pages.

EDUCATION, HISTORY

A HISTORICAL STUDY OF THE EDUCATIONAL THEORIES CONTAINED IN THE CLASSICAL UTOPIAS

(L. C. Card No. Mic 60-1711)

Robert Thaddeus Fisher, Ed.D.
Michigan State University, 1959

The classical utopias were written not only in the spirit of liberalism, but in a genuine atmosphere and feeling of radicalism. The speculations of the utopian writers hinged upon the idea that human institutions had failed to promote social justice. Therefore, it necessarily followed that these institutions would have to be eliminated and replaced by new agencies and modes of living. The reorganization of the political construction of the state was the first proposal each reform writer made; however, each proponent of change felt that education was the primary and efficacious agency in the production of good citizens. Thus each classical utopist necessarily devoted most of his analysis and presentation to educational reform.

Utopian literature has been neglected. The term itself has developed a traditional meaning of unrealistic phantasy. There has been no serious attempt to analyze the concepts contained therein. A study of the classical utopias appeared fruitful particularly in the area of education. This dissertation has attempted to trace the antecedents of modern educational practices in the history of ideas contained in the writings of the utopists.

The right to dissent has been often denied to men. The

utopian writers used a particular form to promote their iconoclastic ideas. Their radicalism was contained under the guise of works of fiction.

The writings of the utopists had several points in common. Each writer was concerned basically with social justice and each was essentially critical of the status quo. However, the utopians as a group offered something new. They gave original contributions in the area of solutions to the problems confronting mankind. The majority of the reform writers were in the main idealistic. They had tremendous faith in the future perfectability of the human race.

The criterion of completeness as well as emphasis upon education was used. The most representative and best known utopias were selected and they included;

- (1) Plato, *The Republic*; (2) Thomas More, *Utopia*;
- (3) Campanella, *The City of the Sun*; (4) Andreae, *Christianopolis*; (5) Francis Bacon, *The New Atlantis*; and
- (6) Jean Jacques Rousseau, *The Social Contract* and *The Emile*.

In the main the utopists were concerned with certain specific areas of education. The first area was concerned with the organization of the schools. Several utopists felt that the schools should be under the direction of an official of the federal government. It was generally agreed that the schools should be organized into primary, secondary and college sections. Curriculum proposals included emphasis upon courses in the sciences, both theoretical and applied, because it was one of the chief means of exploiting natural resources. Women were accorded virtually equal educational opportunities in the utopias. Among the reasons for the inclusion of vocational education was the idea of the fullest possible and efficient utilization of the available resources both men and materials. Courses in character education were also included as was the proposal for adult education. Several of the utopists proposed principles of educational psychology based upon the idea that all learning took place by means of the senses. Because of their attitudes regarding learning several utopists included plans for audio-visual materials and methods in the educational schemes.

The utopists held that education was the most important agency within the state and that every citizen had the right to education to the full amount of his ability.

Microfilm \$3.80; Xerox \$13.30. 293 pages.

A HISTORY OF THE DEVELOPMENT OF THE UNIVERSITY OF TENNESSEE, MARTIN BRANCH.

(L. C. Card No. Mic 60-2497)

Elmer B. Inman, Ed.D.
The University of Tennessee, 1960

Major Professor: W. W. Wyatt

The purpose of this study was to trace the development of certain selected areas of development of The University of Tennessee, Martin Branch, from its beginning as Hall-Moody Institute up to the present time. The school was organized in 1900 by The Beulah Baptist Association, the local association in upper West Tennessee, and control of the school was placed under the direction of a Board of

Trustees appointed by the association. The school remained under the control of this Association until 1917 when control was transferred to The Tennessee Baptist Association. The State Association operated the school until 1927 when Hall-Moody Junior College was consolidated with Union University at Jackson, Tennessee.

The State of Tennessee established Tennessee Junior College by the enactment of Senate Bill Number 301, Chapter nine of the Public Acts of Tennessee. Weakley County purchased the Hall-Moody property and donated the property to the State for the Tennessee Junior College campus. The City of Martin purchased additional land and financed the construction of new buildings on the campus. This period of development continued from 1927 through 1951.

The 1951 legislature passed House Bill Number 264, Chapter number twenty-seven that provided for the establishment of The University of Tennessee, Martin Branch, and the authorization of degree-granting programs in Agriculture and Home Economics. This period of development continued from 1951 through 1957.

The 1957 Legislature passed Senate Bill Number thirty-one, Chapter number three, giving to the Board of Trustees of The University of Tennessee the same powers over the Martin Branch that the Trustees exercised at other schools and colleges of the University. This bill removed the legislative limitations that had been in effect at the college from 1927 through 1957. The Board was granted the power to change the curriculum at the Martin Branch as the need arose and the first action taken by the Board under the provisions of this act resulted in the authorization of a degree granting program in Education. The first class received Bachelor of Science degrees in Education at the end of the 1958-59 school year.

Microfilm \$3.25; Xerox \$11.25. 250 pages.

EDUCATION, PHYSICAL

THE RELATIVE CONTRIBUTIONS OF THREE DIFFERENT TYPES OF PHYSICAL ACTIVITIES TO THE MOTOR ABILITIES OF FIFTH GRADE CHILDREN

(L. C. Card No. Mic 60-2501)

Arlene V. Kilpatrick, P.E.D.
Indiana University, 1960

The purpose of this study was to determine the relative contributions of three different types of physical education activities to the motor abilities of fifth grade boys and girls. It was proposed to determine these contributions by:

1. Testing the hypothesis that there are no real differences in the general motor ability scores of fifth grade children when they have been taught through the media of three different types of physical activities.
2. Testing the hypothesis that there are no real differences in the scores for the specific motor abilities (speed, balance, flexibility, agility, strength, and general coordination) of these fifth grade children when they have been

taught through the media of three different types of physical activities.

A battery of tests designed to measure general and specific motor ability was given to 75 boys and girls in the fifth grades of the public schools of Silver City, New Mexico. The 75 children were assigned at random to three groups and three treatments. The treatments were rhythmic activities, athletic lead-up games, and games of low organization. The treatments were selected on the basis of being activities generally recommended for the elementary school physical education program.

After the initial tests were given the three groups participated in an instructional program for 30 minutes daily over a period of six weeks. Intergroup factors such as the size of the class, sex distribution, length and number of instructional periods, and the instructor, were held constant for all groups. At the end of the six weeks instruction period, the children were again given the original battery of tests.

The data from the two testing periods were compiled and analyzed by two statistical techniques, the Analysis of Covariance and the Kruskal-Wallis One-Way Analysis of Variance. From the analysis of the data secured in this investigation, the following conclusions were made:

1. Programs of rhythmic activities, athletic lead-up games and games of low organization were equal in their effect upon the specific motor abilities of back flexibility, shoulder flexibility, strength, leg power, and static balance.
2. Programs of rhythmic activities, athletic lead-up games, and games of low organization were not equal in their effect upon general motor coordination and the specific abilities of ankle flexibility, agility and general coordination, arm and shoulder-girdle strength and coordination, speed, and dynamic balance. The differences noted were: (a) Games of low organization were superior in producing increases in general motor ability, agility and general coordination, and speed and agility; (b) Athletic lead-up games were superior in producing increases in arm and shoulder-girdle strength and coordination, and dynamic balance; (c) Rhythmic activities were superior only in producing an increase in ankle flexibility.

Microfilm \$2.50; Xerox \$6.60. 137 pages.

THE EFFECT OF THE INTERVAL OF TIME BETWEEN PAIRED VISUAL STIMULI UPON REACTION TIME

(L. C. Card No. Mic 60-2502)

William Bernard Koch, P.E.D.
Indiana University, 1960

Introduction. Rapid successive reactions to sequential stimuli are required of participants in many types of motor skill performance. Limiting successful performance of a task are factors such as the time available to react, the rate at which the body is able to react, and the ability to receive, organize, and respond to a stimulus.

An additional delay, over and above a normal reaction time in an individual's response to a second of two stimuli, has been observed when the stimuli are presented in rapid succession. This additional time-lag in the subject's response has been referred to as the psychological refractory period.

One theory concerning the psychological refractory period is that the central mechanism is unable to efficiently receive and process more than one stimulus at a time when successive stimuli are presented in rapid succession. Another theory suggests that the delay is caused by an expectancy effect. Theories agree that certain characteristics of the central nervous system determine these delays.

Purpose and Procedure. The purpose of this study was to investigate the phenomenon of the psychological refractory period in paired responses. More specifically, the purposes of this study were (1) to find the effect of the manipulation of the interval between pairs of visual stimuli upon the reaction time responses of the right and left hands during paired response conditions, and (2) to compare the obtained results with the somewhat divergent conclusions of previous investigators. Each of the twenty-five subjects were tested four days under simple response conditions and six days under paired response conditions. The subjects reacted to the stimulus light flashes with simple hand movements off telegraph keys. During paired response conditions, the interval of time between stimulus presentation was manipulated within the range 50 through 1000 milliseconds. The analysis of the data took the form of a treatments by subjects design.

Conclusions: The major conclusions indicated were:

1. The mean simple left hand reaction time was significantly faster than the mean simple right hand reaction time.
2. Simple right hand responses were significantly faster than those of the right hand under paired conditions at all except the 50 millisecond interval.
3. In comparing simple left hand reaction times with paired left hand reaction times: (a) at the 50 through 350 millisecond intervals, simple reaction times were significantly faster than paired reaction times; (b) at the 400 and 1000 millisecond intervals, there were no significant differences between them; and (c) at the pooled 450 through 900 millisecond intervals, paired responses were significantly faster than simple reaction times.
4. In comparing the paired left and right hand responses: (a) means of right hand responses at the 50 through 300 millisecond intervals were significantly faster than those of the left hand responses; (b) paired left and right hand reaction time responses at the 350 and 400 millisecond intervals showed no significant difference, and (c) means of the paired left hand responses at 450, 1000, and the 500 through 900 millisecond intervals were significantly faster than those of the right hand responses at these intervals.
5. Dissimilarity of results was suggested when the results were compared with the theoretical predictions concerning (a) the delays in the second reaction time, as well as (b) the magnitude of these delays.
6. In general, the results obtained lend additional credence to the existence of the psychological refractory period, and affirm previous findings concerning the presence of this phenomenon.

Microfilm \$2.50; Xerox \$6.20. 128 pages.

EDUCATION, PSYCHOLOGY

ESTIMATING SUCCESS IN TECHNICAL AND
SKILLED TRADE COURSES USING A
MULTIVARIATE STATISTICAL ANALYSIS

(L. C. Card No. Mic 60-963)

Arthur Dickinson Bradley, Ph.D.
University of Minnesota, 1958

Purpose. The purpose of the study was to establish normative data and to set up prediction equations to estimate scholastic achievement in the major trade and technical courses of a large midwest adult, privately endowed trade and technical institute.

Population. The total sample consisted of 1038 adult male students; 719 in the validation group (Group I) enrolled during the school year 1953-1954, and 319 in the cross validation group (Group II) enrolled during the school year 1954-1955. The students were enrolled in 17 courses that make up the trade and technical curricula of the school. The sample consisted of all students who attended long enough to receive grades (one month to 18 months).

Procedure. A biographical questionnaire was administered to all available members of the student population for both school years.

It was possible to obtain test information and background data on 90 per cent of the total sample. The ten per cent not available were foreign students with reading problems, students who entered after registration day, and those who were unavailable because of illness or personal reasons.

Tests administered to Group I included the Army General Classification Test, Form AM (AGCT), the Bennett Mechanical Comprehension Test, Form AA (Bennett), the Kuder Preference Record-Vocational, Form BM (Kuder) and the Revised Minnesota Paper Form Board, Form MA (RMPFB). Tests administered to Group II were the AGCT, Bennett, RMPFB, the Minnesota Vocational Interest Inventory (MVII) and the Woody-McCall Mixed Fundamentals in Arithmetic, Form I (Woody-McCall). The questionnaire, the AGCT, the Bennett and the RMPFB were common to both Groups I and II.

Criterion. The criterion was student scholastic achievement in the 17 courses of study. The grades were an average of the four general areas in which students were graded at the school.

Design and Method of Analysis. For the problem in estimation the study was designed so that the prediction equations were established on the validation students Group I (719 in 1953-54) and cross validated on Group II (319 in 1954-55) students.

The analysis was completed using a multiple regression program for the IBM 650 calculator. From the electronic computer output, means, standard deviations, zero order correlations, partial correlation coefficients, multiple regression equations, multiple correlation coefficients, predicted scores, residuals and the standard errors of multiple estimate were obtained. In the initial phase of the program 42 variables were studied. In the final multiple regression analysis the three most efficient independent variables were used (AGCT, Bennett, and RMPFB) with the dependent criterion variable (grades).

Results. Multiple correlation coefficients calculated for ten courses that enrolled 85 per cent of the students, ranged from .62 to .75 with the average for the ten courses being .69.

Normative and descriptive data for 38 other factors were studied and reported about students in the 17 courses which make up the curricula of the school.

Conclusions. It was possible to set up prediction equations at this adult nonproprietary trade and technical school by courses that yielded multiple R's of as high magnitude as those in the literature for measuring college achievement when using the same types of variables with a grade criterion.

Microfilm \$7.10; Xerox \$25.20. 558 pages.

THE REALISM OF LEVEL OF ASPIRATION
DISPLAYED BY MENTALLY HANDICAPPED
CHILDREN IN THE REGULAR GRADES
AND IN SPECIAL CLASSES

(L. C. Card No. Mic 60-2608)

James Robb Lent, Ed.D.
Syracuse University, 1959

The purpose of this investigation was to compare the relative degrees of realism displayed on two academic type level of aspiration tasks by mentally handicapped subjects in the special classes and those in the regular grades. Realism was defined as the ability to match aspiration closely to performance, in a positive direction, while responding in a flexible manner to success and failure on a series of trials.

Theory and description of behavior of mentally handicapped children given by experts in the field suggested that the behavior of the retarded child is affected by the pressure (real or felt) to conform to the standards of his intellectually normal chronological age peers, especially in the area of academic achievement. It has been demonstrated that retarded children in the regular grades are isolated and rejected on the basis of undesirable, ego-defensive, compensatory behavior, which is possibly a result of the feelings of failure engendered by academic failure. Previous research in the area of level of aspiration has associated feelings of inadequacy and lack of self-confidence with unrealistic goal-setting behavior. It was reasoned, therefore, that children regularly enrolled in special classes, which have the stated aim of engendering feelings of adequacy and security, will be more realistic in regard to experimental reading and arithmetic level of aspiration tasks than retarded children in the regular grades. In order to evaluate this hypothesis, tasks were designed and a scale devised to measure degree of realism in level of aspiration behavior.

Twenty-five subjects were selected from the regular grades and 25 from the special classes. The groups were selected to be comparable in terms of chronological age, mental age, and intelligence quotient, and were drawn from central school districts in the central New York State region. Subjects ranged in age from 10 to 15 years, with a mean intelligence quotient of 71.

A reading type and an arithmetic type task were

designed for the level of aspiration measurement. The tasks were administered to the subjects individually with a separate session for each task. Goal discrepancy scores and patterns of response to success and failure were tabulated for each subject on each task.

Previous research by Sears, Irwin, and others, and as summarized by Lewin, et al., had indicated practical criteria for regarding goal-setting as realistic or unrealistic. However, as suggested by Cohen, such descriptions were considered to be fragmentary, describing only a particular category of goal discrepancy or pattern of response in terms of realism. These descriptions did not, it was thought, adequately describe the total dynamics of the goal-setting process, nor did they suggest ways of quantifying such observations. A method for assessing degree of realism was devised that combined the influence of goal discrepancy scores and patterns of response. In this way, each subject received a realism score that was an additive combination of the score received for goal discrepancy category (high-positive, low-positive, low-negative, high-negative and high-variability) and pattern of response (flexible, achievement follower, rigid or arbitrary).

The first analysis of results indicated that the two groups differed in terms of realism. When these data were examined specifically in terms of tasks and groups, it was possible to conclude as follows:

1. Special class subjects displayed a significantly higher degree of realism on the experimental arithmetic task than did subjects in the regular grades.
2. The difference in degree of realism displayed on the experimental reading task between subjects in the special classes and regular grades was not statistically significant.
3. The difference in degree of realism displayed between the reading and arithmetic experimental tasks by subjects in the special classes was not statistically significant.
4. The difference in degree of realism displayed between the reading and arithmetic experimental task by subjects in the regular grades was not statistically significant.

Statistically significant differences were obtained between the groups in terms of actual academic achievement. Regular class subjects were higher achievers in reading and arithmetic. Inasmuch as special class subjects were seen to be more realistic in regard to the arithmetic type experimental task while actually being the poorer achievers in this subject, it was considered that support had been received for assuming that certain, as yet not clearly defined, personality factors were affecting level of aspiration behavior on these familiar tasks.

Microfilm \$2.50; Xerox \$5.60. 112 pages.

INSIGHTS OF THE MIDDLE-AGED CHILD CONCERNING THE PARENT IN A HOME FOR OLD PEOPLE

(L. C. Card No. Mic 60-1718)

Rachel Perkins Noll, Ph.D.
Michigan State University, 1959

Major Professor: Walter F. Johnson

The personal interview method was used in an attempt to (1) investigate the closeness of relationship between the parents living in a Home for Old People and their adult child who was responsible for the parents' affairs; and (2) to investigate the extent of guilt feelings on the part of the child in regard to her or his care of the parent. It was felt this purpose could be accomplished by attempting to determine the amount of insight and knowledge possessed by the child in regard to the activities, interests, feelings, and attitudes of the parent.

A population of 29 parents over 65 years of age and three parents between 50 and 60 years of age from two Homes for Old People were interviewed using the Schedule entitled "Your Activities and Attitudes" developed by Ruth S. Cavan, Ernest W. Burgess, Robert J. Havighurst of the University of Chicago. The adult middle-aged child who was responsible for his or her parent's affairs was also interviewed in regard to the parent using a copy of the same questionnaire, but with appropriate changes in pronouns to fit the sex of the parent and insertion of a few pertinent questions. The responses were compared to see how much agreement there was thus indicating the amount of insight into and knowledge of the activities, interests, feelings, and attitudes of the parent held by the child.

In addition to the questionnaire, certain open-end questions were asked informally of both parent and child to point up the parent's feeling about living in a Home for Old People and about the care received from the child, and to point up the child's feelings in regard to his care of the parent and the child's insight into the feelings of the parent about this. Responses were interpreted in regard to guilt feelings toward the parent where appropriate.

The findings were:

1. There was a greater number of responses in agreement between the parent and child on Attitudes of the parent than on the Activities and Interests of the parent.
2. While a substantial majority of the parents were living at the Homes through necessity, most of them were satisfied with the place of residence.
3. Most of the parents strongly advised against living with one's children although a substantial majority had done so.
4. While a bare majority of parents at the Home for Women were satisfied with the care and attention given by their children, a substantial majority at the other Home were not satisfied as evidenced in response to an oblique question on whether adult children take care of old parents the way they should.
5. Most of the adult responsible children felt they should be doing more for their parents but most did not feel they should have their parents living with

them again. (Most of the parents had lived with their adult responsible children anywhere from a few weeks to 23 years.)

6. Most of the adult responsible children felt that their parents were satisfied with the attention and care received from their children and a majority felt that their parents did not want to live with them.
7. Guilt feelings on the part of the child regarding the parent seemed to be evidenced in connection with a few responses.

The conclusions were:

1. There was a reasonable amount of "inner" understanding of the parent by the child. The relationship was close rather than distant.
2. Most of the parents were satisfied with the place of residence.
3. However, a majority of the parents were not satisfied with care given old people by their adult children, therefore, probably not satisfied with care given by their own children. It would seem then that a majority accepted the situation intellectually but not emotionally.
4. While guilt feelings seemed to be manifested in a few places by the child in regard to the parent, they did not seem strong or general.

Microfilm \$4.65; Xerox \$16.45. 364 pages.

THE READING AND SPELLING ACHIEVEMENT
OF A GROUP OF ENGLISH CHILDREN AS
JUDGED BY THE STANDARDS ON AN
AMERICAN ACHIEVEMENT TEST

(L. C. Card No. Mic 60-2564)

Geraldine Teresa Scholl, Ph.D.
University of Michigan, 1960

The purpose of this study was to assess the reading and spelling achievement of a sample of English children in terms of the norms on an achievement test standardized in the United States. It was believed that such a study might demonstrate the effect that certain educational practices in England have on reading and spelling achievement. To begin with, schools in England tend to introduce children to reading about a year earlier than do schools in the United States. Then too, English schools are inclined to be more academically oriented than schools in the United States. This academic orientation may be attributed at least in part to the assessment which is employed at age 11 to stream children into various secondary programs. Anticipating this assessment, English schools tend to concentrate on reading and the other basic tool subjects during the early school years.

The study was conducted in Burton-upon-Trent, Staffordshire, England. The subjects consisted of a systematic sample of Burton children attending schools corresponding to the public schools of the United States. The sample was limited to the ages 7, 9, 11, and 13.

The tests used with the subjects were the paragraph

meaning, word meaning, and spelling subtests of the Stanford Achievement Test. One-half the subjects at each age were given the original form of the test and one-half a modified form adapted to the language usage of English people. Only the paragraph meaning and word meaning subtests were different for the two groups.

The findings were as follows:

1. At each age, the group taking the adapted form of the test made lower mean scores than the group taking the original form on both paragraph meaning and word meaning, although none of the differences was significant at the .05 level.
2. On the word meaning subtest the mean scores of both groups at each age were above the norm with the exception of the group taking the adapted form of the test at age 9. Differences were significant at the .05 level or better for one group at age 7 and for both groups at age 13.
3. On the spelling subtest the mean scores of both groups were above the test norm at each age. Differences were significant at the .05 level or better for both groups at age 7 and for one group at age 11.
4. On the paragraph meaning subtest the mean scores of both groups at each age were below the norm with the exception of the children at age 7 who took the original form of the test. Differences were significant at the .05 level or better for both groups at ages 9 and 11.
5. Positive and significant correlations between IQ's and scores on each of the three subtests were obtained at all ages.

The above findings permit the following general statements:

1. The mean spelling achievement scores of Burton children are somewhat higher than the Stanford Achievement Test norms for this subtest.
2. In general, the mean reading vocabulary scores of Burton children are somewhat higher than the Stanford Achievement Test norms for word meaning.
3. In general, the mean paragraph meaning scores of Burton children are somewhat lower than the Stanford Achievement Test norms for this subtest.
4. The reading and spelling test scores of Burton children bear positive and significant relationships to their IQ's.

On the whole, the results of the present study are not characterized by large differences between the reading and spelling achievement of Burton children and the Stanford Achievement Test norms. Perhaps the outstanding finding concerns not the differences but how closely the performance of these Burton children approximates the Stanford Achievement Test norms at the ages investigated.

Microfilm \$2.50; Xerox \$5.40. 106 pages.

INTER- AND INTRA-PERSONAL ADJUSTMENT
OF ADOLESCENTS TESTING AT THE
SUPERIOR AND AVERAGE LEVELS
OF INTELLIGENCE

(L. C. Card No. Mic 60-2615)

Donald Curtis Smith, Ph.D.
Syracuse University, 1960

The purpose of the study was to determine whether differences existed between groups of adolescents of superior and average intelligence in interpersonal and intrapersonal adjustment.

The basic premise of the research was that too much stress was being placed in professional literature on the superior adjustment of highly intelligent individuals. This extreme emphasis did not appear to be warranted by previous research because:

1. Only slight differences between groups of Superior and Average subjects had actually been reported.
2. Research samples had often differed significantly in social class status, nationality and religion as well as in intelligence.
3. Research criteria for adjustment had most often been based on superior character traits, social status, and conformity to the values of the social milieu.

Other definitions of adjustment seemed to be of equal and perhaps of more importance.

A comparison was made of 42 adolescents of superior intelligence and 42 adolescents of average intelligence. Both experimental groups were closely equated on social class status, sex, age, and religious and nationality background. An Interpersonal Adjective Check List was administered to obtain ratings of self-concept and ideal self-concept, and used for teacher and classmate evaluations of subjects. The Thematic Apperception Test was also administered to each experimental subject.

Six criteria for interpersonal and intrapersonal adjustment were proposed. The incidence of Independent-Dominant and Responsible-Cooperative interpersonal traits was assumed to represent conformity to social values and "active adjustment." A consistently higher incidence of these traits on the basis of teacher, classmate and self-ratings was considered as one definition of superior interpersonal adjustment. Moderation or Appropriateness of interpersonal traits, a second criteria for interpersonal adjustment, was assessed by means of teacher, classmate and self-ratings on the Interpersonal Check List. Two criteria, Integration of Personality and Self-Acceptance, were assumed to measure inner conflict and feelings of self-adequacy. The former was measured by the correspondence of self-concepts of interpersonal behavior and interpersonal themes on the TAT, the latter, by the correspondence of self-concepts and ideal self-concepts. The sixth criteria, Accuracy of Self-Perception, was measured by the correspondence of teacher-peer ratings and self-ratings.

The results disclosed that, on the basis of these research criteria and methods of assessment:

1. Superior and Average adolescents, except for one significant difference were very much alike in their

interpersonal and intrapersonal adjustment. No significant differences were found between groups in terms of teacher and classmate ratings of the incidence of overt Responsible-Cooperative interpersonal traits, or in terms of consistent moderation of interpersonal traits, feelings of self-acceptance, accuracy of self-perception, or degree of intrapersonal conflict.

2. The outstanding difference between Superior and Average groups was a consistently higher incidence of Independent-Dominant interpersonal traits on the part of Superior subjects.

Thus, Superior subjects appeared to demonstrate relatively better adjustment on the basis of a higher incidence of Independent-Dominant traits. However, they experienced inner conflict, possessed feelings of personal inadequacy and showed inappropriate interpersonal traits just as frequently as Average subjects. They also failed to demonstrate superiority in terms of accuracy of self-perception and a higher incidence of the socially-approved traits, Responsibility and Cooperation.

Despite several limitations of the study, the results suggested that

1. High IQ by itself was not the ultimate criterion for superiority in interpersonal and intrapersonal adjustment.
2. The needs of Superior adolescents for individual guidance and for teacher recognition of their inner conflicts and problems in relating to others were no less important than the needs of Average adolescents. Microfilm \$2.95; Xerox \$10.35. 228 pages.

SOME FACTORS RELATED TO RESPONSE
DELAY AND ACADEMIC ACHIEVEMENT

(L. C. Card No. Mic 60-2639)

Naoma D. Watrous, Ed.D.
The University of Oklahoma, 1960

Major Professor: Dr. P. T. Teska

This study represents an attempt to determine some of the relationships between academic success and certain specified variables. A Picture Card Series Test was designed to study the relationship between response delay and these three classifications: reverser and non-reverser, achievement, and OSPE scores. This test was composed of 47 picture cards divided into four subtests: conflict (17 cards), family--non-family (15 cards), boy-girl (10 cards), authority (5 cards). Each picture card contained five randomly placed pictures. Four of the five pictures were of a common content matter, while the fifth picture differed in content. The fifth picture, called the conflict picture, was matched in all respects except content with the other four pictures.

The modal time of response to the stimulus cards was used as a point from which to measure deviation. Subjects who deviated in response delay were identified and statistical comparisons made with reference to their

grade-point averages, OSPE scores, and reverser and non-reverser designation.

The results of the study demonstrated the following:

1. The reversers had high OSPE scores.
2. The non-reversers had low OSPE scores.
3. The reversers had lower grade-point averages than non-reversers.
4. Reversers and non-reversers did not differ significantly in relation to displacement on the Picture Card Series. There was a consistent trend for the reversers to displace.
5. High and medium subjects combined showed a tendency to displace more often than low-achieving subjects.
6. There was statistical difference in displacement of high- and medium-achieving subjects and low-achieving subjects.
7. Low achievers showed a tendency to have more extreme position responses.
8. The low-achieving subjects showed a statistically significant difference in delay response to the conflict, family--non-family, and authority subtests of the Picture Card Series than the high- or high- and medium-achieving subjects combined.

Certain uncontrolled variables were discussed and suggestions made for further research.

Microfilm \$2.50; Xerox \$4.60. 87 pages.

EDUCATION, TEACHER TRAINING

THE PREPARATION OF A HANDBOOK OF ADMINISTRATIVE PRACTICES IN AUDIO-VISUAL EDUCATION FOR THE WEST VIRGINIA PUBLIC SCHOOLS

(L. C. Card No. Mic 60-1938)

Gordon Page Corbitt, Ed.D.
New York University, 1960

Chairman: Professor Irene F. Cypher

The Problem

The purpose of this study was to prepare a handbook of case examples of audio-visual practices supplemented, in limited form, with basic elemental facts concerning audio-visual materials and practices to motivate public school administrators to become more than incidentally informed about audio-visual education and what it can do for their schools. The handbook was designed primarily for use in West Virginia.

The Need

State educational reports have shown that not more than five of the fifty-five county school systems of West Virginia have a director of audio-visual education and that there is no state supervision in this field. The findings of the investigator's survey pointed up roadblocks that were hindering the development of audio-visual programs at the local and state level.

The need for motivation for greater use of sensory materials in instruction was officially expressed by the State Superintendent of Schools in a State Guide published in 1951. The fact that, today, more than 90 per cent of the county-unit school systems of the state are still without organized audio-visual programs attests to the continuing need for greater motivation.

Professional literature and the investigator's experience indicate that case examples of practical and tested practices or ideas for improving instruction are a source of motivation for experimentation and further study. To find such audio-visual case examples a search must be made through many pages of the literature. This study has been undertaken to bring case examples into a single source, a handbook.

The Method

Educational Index was surveyed to determine ten periodicals carrying the largest number of articles pertaining to the administration of audio-visual education during the period 1948-1955, and the five periodicals carrying the largest number under audio-visual headings other than administration during the period 1953-1955. Issues of the fifteen periodicals were scanned for the eight-year period, 1948-1955, for tested and effective practices in audio-visual education. In order that examples selected might be reasonably up to date, they were not limited to issues of periodicals published during the eight-year period indicated. Later issues of the same and other periodicals were likewise scanned.

Twelve audio-visual textbooks were selected from those listed in the library files of New York, Ohio State and West Virginia universities. These references were scanned.

Ten audio-visual handbooks, manuals or guides, recommended by the Department of Audio-Visual Instruction of the National Education Association, or secured from sources listed by that Department, were likewise scanned. The 1954 DAVI yearbook was given special consideration in the survey.

Since the case examples had been accepted as materials for publication in the educational publications surveyed, it was assumed that they had been considered effective. In further consideration, direct or implied statement of usage for at least one school year was considered a further test of effectiveness of the examples, as was a direct or implied recommendation for continued use.

After case examples, applicable to topics under discussion in the handbook, were preliminarily selected they were evaluated by three officially recommended West Virginia educators. Examples passing this evaluation were subjected to a final evaluation in the light of two evaluative criteria arbitrarily selected from a list furnished by representative audio-visual educators throughout the United States.

To determine roadblocks that have retarded the development of audio-visual programs in the state and suggested methods for their elimination, a questionnaire survey was sent to representative administrators and other educators in the state. Audio-visual administrators in the state were requested to indicate a desirable size for the handbook, if published.

Findings

Case examples were found to be increasingly used in educational publications for purposes of clarification of procedures and for motivation.

Microfilm \$5.30; Xerox \$18.70. 413 pages.

A STUDY OF EXPRESSED ATTITUDES OF PROSPECTIVE TEACHERS, TAKING PART IN PRACTICAL CONSERVATION ACTIVITIES.

(L. C. Card No. Mic 60-2609)

George Milton Laug, Ph.D.
Syracuse University, 1960

It has long been recognized that deep seated attitudes have a very great impact upon the effectiveness of teaching conservation. The investigator has attempted to measure changes in expressed attitudes of prospective teachers as a response to practical conservation activities. The practical experiences were of two types. The greater majority of students were engaged in a one day conservation trip to the college camp of New York State College for Teachers at Buffalo located in Franklinville, N. Y. The activities for the day group were of the work type, shrub and tree planting, and also observational activities such as pond study and ecology. A considerably smaller group spent two days at this camp which involved more activities, particularly of the non-work type. Both groups were also taught conservation in the classroom from a unit outline constructed in anticipation of these trips. A control group had neither instruction by the unit outline nor the field trips.

Various difficulties arose regarding an adequate measurement of attitudes, but eventually a Likert type attitude scale was constructed. Attitude items were utilized according to frequency of verbal and written expression. The validity of these items was established by eight well qualified persons in the field of science and conservation education. Only those items in which six out of eight experts agreed regarding validity were retained. The mode of response of the experts to the attitude items was utilized in grading the attitude scale. A reliability coefficient of .94 was established for the final scale. The Pearson product moment "r" and Spearman-Brown prophecy formula were utilized. Considerable care was taken in order that the attitude scale would be uniformly and easily administered. All reactions of students were held strictly confidential by the use of a student number drawn at random from a box. The attitude scale was administered to the students of both the experimental and control groups well in advance of any treatment of conservation and again following this treatment.

The entire experimental group showed a statistically significant change in attitude score from the first to the second administration of the scale. The control group showed such a change but in an unfavorable direction. Within the experimental group some students did not go on any field trips. They showed no significant change from the first to the second administration of the scale. The greatest advance in mean score from the pre to the post-testing was with those students having an overnight field

trip activity. However, in the pre-test, the mean of the over-night students was significantly higher than the mean of day trip students. When both field trip groups were combined and compared with those who missed the trips in the pre-testing no significant difference appeared. The possible effect of instructors both in the experimental and control programs showed statistically significant differences between these instructors following the treatment of conservation in both programs. All instructors in the experimental program showed significant advances from the pre to the post-testing situation. All further statistical treatment involved the experimental field trip groups. Poor weather seemed to have no significant effect upon attitude scores. Rural students had significantly better scores than either suburban or urban students in both pre and post-testing. Academically above average students did significantly better in the pre and post-testing situation. Various background factors were considered. Sex, lack of high school biology, boy and girl scout activity had no significant effect in either the pre or post-test situation. 4-H club activity did show a significant difference in the mean in the pre-testing situation.

Microfilm \$3.25; Xerox \$11.50. 252 pages.

THE MASTER OF TEACHING DEGREE AT OKLAHOMA STATE COLLEGES

(L. C. Card No. Mic 60-2637)

Raymond Paul Semones, Ph.D.
The University of Oklahoma, 1960

Major Professor: Claude Kelley

The problem of this study was to analyze and interpret the Fifth-Year programs of the six state colleges of Oklahoma, as they developed and operated in their first five years.

The historical method and normative survey were used to secure data.

Conclusions drawn from the study were:

- (1) In 1953 the North Central Association was thought by the administrators of the six state colleges to be interested in a fifth-year program of teacher-preparation which was based on individual needs of teachers, rather than on usual graduation standards. The administrators of the six state colleges, by following or appearing to follow such a program, hoped to receive North Central Association accreditation of their Master of Teaching degree programs.
- (2) The preparation of school administrators, while specifically obviated as a purpose of the Master of Teaching program by the Oklahoma State Regents for Higher Education has since been accepted by the Oklahoma State Regents for Higher Education as an acceptable purpose of the programs.
- (3) There was no consistent leadership in the office of the Oklahoma State Regents for Higher Education. This is evidenced by the lack of effort of this office to:
 - a. determine if need existed for the requested program.

- b. determine if the colleges followed the requirements included in the authorization for the program.
- c. prevent unnecessary duplication of programs when graduate programs for the preparation of administrators was requested.

It is recommended that the results of this study be used in establishing the need for:

- (1) An evaluation by an appropriate outside professional group of the system of higher education in Oklahoma with special reference to the element of coordination for one system.
- (2) A critical study of the relations between the Oklahoma State Regents for Higher Education and the boards of control of the various state institutions of higher education.

It is further recommended that the following studies be made:

- (1) A comparative study of fifth-year programs of teacher-education throughout the United States.
- (2) A study of the fifth-year programs in Oklahoma to determine the strengths and weaknesses of the programs, and the degree to which their purposes are currently being realized.

Microfilm \$2.50; Xerox \$6.00. 121 pages.

A FOLLOW-UP STUDY OF DOCTORAL
STUDENTS IN EDUCATION AT THE
UNIVERSITY OF MICHIGAN WHO HAVE
SUCCESSFULLY COMPLETED THE
PRELIMINARY EXAMINATIONS BUT HAVE NOT
COMPLETED THE DOCTORATE, 1946-1953.

(L. C. Card No. Mic 60-2585)

William Hirn Wetherill, Ph.D.
University of Michigan, 1960

This is a study of the graduate students of the Horace H. Rackham School of Graduate Studies and the Department of Education, University of Michigan, who successfully completed the preliminary examination for the doctorate during the years 1946 to 1953, inclusive, but did not complete the degree.

Its purposes are (1) to secure the opinions and assessments, of these graduate students, of their graduate preparation program at the University of Michigan; (2) to determine the status of this group of graduate students in their chosen profession; (3) to determine the reasons for their failure to carry the doctoral program to a satisfactory conclusion; and (4) to compare this group of graduate students with those who have successfully completed the doctorate, in terms of certain factors which might be related to the completion of the doctorate.

Eighty graduate students successfully completed the preliminary examinations for the doctorate in education during 1946-1953 but have not as yet completed the degree. Questionnaires were sent to the seventy-five of these

students who could be contacted. Sixty-two usable questionnaires were returned. The records of the University of Michigan were examined to secure additional information about these students.

Students who had not completed the doctorate were matched with a selected group of students who had completed the doctorate. Information concerning the students who had completed their degree was secured through a second questionnaire, from records of the University of Michigan, and from data collected by the questionnaire used in the doctoral dissertation of Dr. Raymond Lokers.¹ Comparisons on certain selected factors were made between those completing the doctorate and those who discontinued their doctoral programs.

Forty-four percent of the graduate students who had not completed the doctorate were employed in colleges or universities. A majority of these students held positions with some administrative responsibility. Forty percent of the noncompleting students were employed in public school service. Two-thirds of this group were holding public school administrative positions such as superintendencies, elementary and secondary school principalships, and positions as coordinators or directors of special school services.

A majority of the respondents indicated that their graduate programs at the University of Michigan had made substantial contributions to their necessary professional knowledge and skills, to their continued intellectual growth, and to a broader grasp of educational problems.

Three major conclusions can be drawn from this study:

1. The graduate students studied were, in general, satisfied with their graduate preparation programs.
2. The interaction of a variety of factors caused these students to discontinue their doctoral programs, the most important of which were their responsibilities having to do with their positions in the field, and the financial responsibilities they had assumed.
3. No outstanding differences were found between students completing the doctorate and those who discontinued their programs on such factors as influences motivating graduate work, general scholastic average, and financial support received during the years of graduate work. Of those who had been awarded the doctorate, a larger percentage had written a master's thesis.

Microfilm \$3.75; Xerox \$13.30. 292 pages.

1. Raymond J. Lokers, "An Evaluation of the Doctoral Program in Education at the University of Michigan, School of Education in Terms of Fulfillment of the Expectations of the Recipients and of the Expectations of the University" (unpublished doctoral dissertation, University of Michigan, 1958).

AN ANALYSIS OF THE SOCIAL STUDIES
TEACHER EDUCATION CURRICULUM IN
SELECTED TENNESSEE INSTITUTIONS

(L. C. Card No. Mic 60-2499)

Ralph Lee White, Ed.D.
The University of Tennessee, 1960

Major Professor: L. O. Haaby

This abstract contains a resume of the problems, procedures, and findings resulting from an analysis of the social studies teacher education curricula of selected Tennessee institutions.

Problem

The problems in this study were two in number:

1. To analyze selected social studies teacher education curricula in light of requirements and recommendations made by the State Board of Education of Tennessee and the National Council for the Social Studies.
2. To determine if American history and economic concepts recommended by a jury of college professors were considered in the social studies teacher education curricula of selected Tennessee colleges and universities.

Sub-problems

1. To identify the social studies teacher education curricula of the institutions studied.
2. To identify the Tennessee State Board of Education's requirements regarding general education, professional education, and social studies endorsement.
3. To identify the National Council for the Social Studies' recommended program for teacher education.
4. To select American history and economic concepts that seemed to be given most attention in content recommended by professors of American history and economics.
5. To submit selected concepts to a jury of college professors to be rated for the desirability of their inclusion in the social studies teacher education curriculum.
6. To analyze the American history and economic courses required for social studies teachers in the institutions studied in the light of concepts recommended by a jury of college professors.
7. To summarize and draw conclusions based upon the findings of the study.

Procedures

The institutions to be studied were selected by choosing the four State institutions which graduated the largest number of social studies students during the school year 1956-57. The four institutions were: the University of Tennessee, East Tennessee State College, Middle Tennessee State College, and Memphis State University.

Tennessee's regulations for the certification of teachers and the National Council for the Social Studies' recommended social studies teacher education program were used as standards against which the analyses of course and hour requirements in general education, professional education, and social studies endorsement were made.

Analyses of American history and economic courses were made to determine if recommended concepts were considered in the courses required for prospective social studies teachers. With the assistance of college profes-

sors in both fields, one hundred American history concepts and one hundred economic concepts were selected for consideration by juries of ten American history and ten economic professors. The jurors were asked to rate each concept according to the following scale: 3--very desirable; 2--desirable; 1--of slight or questionable desirability; 0--undesirable. "Desirability" was defined as the extent to which the juror recommended the concept be included in the curriculum. Eighty of the American history and eighty-seven of the economic concepts were indicated as recommended.

A questionnaire utilizing the recommended concepts was developed and distributed to professors responsible for teaching the courses required of prospective social studies teachers in each of the selected institutions. The respondents were asked to indicate if the concepts were included in: the texts used, outside readings required, lectures presented, or sources other than these.

Findings

The findings of the study indicated that:

1. The State's requirements were met or exceeded by each of the selected institutions in all the areas compared.
2. None of the selected institutions met all of the recommendations of the National Council for the Social Studies.
3. Only the National Council's recommendations concerning professional education were met by all of the selected institutions. Recommendations pertaining to general education and social studies endorsement were only partially met by each of the institutions.
4. A majority of the recommended American history and economic concepts were reported by each of the selected institutions as being included in the sources investigated. Microfilm \$2.65; Xerox \$9.25. 201 pages.

EDUCATION, THEORY AND PRACTICE

AN INVESTIGATION OF THE EFFECTIVENESS
OF INSTRUCTION DESIGNED TO IMPROVE
THE READER'S SKILL IN USING CONTEXT
CLUES TO DERIVE WORD MEANING

(L. C. Card No. Mic 60-2602)

Eugene Alexander Guarino, Ph.D.
Syracuse University, 1960

Students should be helped to develop a high degree of competence in deriving the meanings of new words. It has been pointed out that context provides the best source of understanding in making new meaning associations, that readers often fail to use effectively clues to word meaning found in printed context, and that instruction should be given to promote ability to derive word meaning from context.

Purpose.—The present study was undertaken to test whether instruction in the context clue approach to deriving word meaning is effective. That is, do high school students who are made aware of various types of context clues and who are given practice in using them show improvement in reasoning from context when compared with other students who have received no instruction?

Method. - Test-type instructional materials were prepared for use with tenth-graders. The unit consisted of eleven lessons including: (1) developing awareness of and applying five types of context clues: definition, synonym, comparison or contrast, summary, and experience, and (2) determining the meanings of unfamiliar words encountered in four reading passages.

The teaching phase of the experiment was carried out in two steps. The first experimental group consisted of three tenth-grade English classes. The writer taught the unit. Eight class periods of instruction were given over a period of one month. Three other classes were assigned as the control group. The control group totaled eighty-two subjects, the experimental group totaled eighty-five.

Six English teachers later used the eleven lessons with their tenth-grade classes. Six other classes were assigned as controls. Control subjects totaled 148, experimental subjects totaled 153.

Two forms of a test measuring ability to use context clues to word meaning were used as pre and post-tests with all groups. A reading comprehension test was administered for use in equating groups.

The performance of experimental and control subjects in using context was compared. Correlations between context ability and related variables were computed. The performance of ninth, tenth, and eleventh-graders on the context ability test was compared.

Conclusions. - The findings resulted in four major conclusions: (1) Instruction in context clues results in significant improvement in ability to infer the meanings of unfamiliar words encountered in reading passages. (2) Students with low initial context ability and high level of reading comprehension benefit most from instruction. (3) Improvement in context ability is to be expected from grade to grade at the high school level. (4) Ability to use context clues to infer word meaning is significantly correlated with intelligence and reading ability. Microfilm \$2.65; Xerox \$9.25. 202 pages.

A STUDY OF THE REASONS GIVEN FOR THE LIMITED USE OF CERTAIN AUDIO-VISUAL MATERIALS AT SYRACUSE UNIVERSITY

(L. C. Card No. Mic 60-2605)

Richard Dean Hubbard, Ed.D.
Syracuse University, 1960

Supervisor: Professor Don G. Williams

Foremost among the big educational problems to be faced today is the rising school population especially at the university level. If audio-visual methods and materials are to serve in easing this problem, then it is necessary to know the deterrents standing in the way of present usage. It was the purpose of this study: (1) to determine a rank order of deterrents at the university level, (2) to compare these with the obstacle list already developed for the public school level, (3) to develop and test a questionnaire that might be applied by any institution in evaluating its audio-visual program, (4) to find what characterizes "users" and "limited users," (5) to suggest areas and techniques in improving an Audio-Visual Service, and (6) to point up problems for further research.

A check-list questionnaire was developed and distributed to all the teaching faculty at Syracuse University; 315 persons responded representing 32 schools or colleges and all academic ranks. These resulting data, in addition to information from the Audio-Visual Service files and materials' catalogs, were first divided into "user" and "limited user" categories and then served in discussing "factors mentioned as deterrents over which an Audio-Visual Service has little control" and "factors mentioned as deterrents which an Audio-Visual Service can overcome."

Only four personal factors were found to have significant relevance to audio-visual utilization. These included academic load, teaching load, public school teaching experience, and formal audio-visual training.

The greatest deterrents were found to be: (1) lack of classrooms with adequate facilities to use audio-visual materials, (2) difficulty in getting the right material when needed, (3) lack of appropriate materials at the college level, (4) lack of adequate budgets to keep certain kinds of materials and equipment decentralized, and (5) lack of information on audio-visual sources. These differed significantly from public school teachers' emphasis on the lack of audio-visual administrators and coordinators, the lack of Audio-Visual Centers, and teacher inertia. Therefore, it was concluded that the findings concerning deterrents at the public school level cannot be applied appropriately in solving similar problems at the university level.

The Audio-Visual Service, in spite of its many efforts, was not: (1) communicating effectively with the faculty, (2) making it easy for acquiring materials and equipment for class use, and (3) serving as an adequate source of audio-visual information. An extensive list of activities was suggested for improving the Service.

Limited users listed deterrents in nearly the same order as users but did have distinguishing characteristics such as: (1) the lack of public school experience; (2) little or no formal audio-visual training; (3) teachers made little and/or poor use of instructional materials; (4) limited preview of materials; and (5) the attitude that materials in his field were inadequate, special help was not readily available, and his field could not be "visualized."

Users were the reverse of the previous list of characteristics. They also tended to feel the worthwhileness of using audio-visuals, knew the Audio-Visual Services and sources of materials, used a variety of instructional media, kept a personal file of information, and received help from their professional organizations.

There is a definite lack of appreciation and understanding of the audio-visual field and a lack of adequate and appropriate materials beyond the public school level of teaching. An Audio-Visual Service can do little to directly solve these problems but needs to recognize what kinds of deterrents can be overcome.

From the findings of this study, the following recommendations may be made: (1) to expand the Audio-Visual Service to better meet instructional needs; (2) to improve the lines of communication between the faculty, administration, and Audio-Visual Service; (3) to improve faculty attitudes toward the newer teaching media; and (4) to use the questionnaire at regular intervals to measure the efficiency and effectiveness of an Audio-Visual Service. Further research is suggested in six problem areas of the Audio-Visual field.

Microfilm \$3.15; Xerox \$11.05. 242 pages.

ENGINEERING

ENGINEERING, AERONAUTICAL

STABILIZATION OF GASEOUS DETONATION WAVES WITH EMPHASIS ON THE IGNITION DELAY ZONE

(L. C. Card No. Mic 60-2554)

James Arthur Nicholls, Ph.D.
University of Michigan, 1960

The characteristics of gaseous detonation waves are considered insofar as they influence the dynamic conditions that must be met in order to generate a standing gaseous detonation wave. In view of these requirements, a few possible methods of stabilization are presented and discussed. The method adopted for the experimental study consists of mixing unheated hydrogen with heated air in the supersonic portion of an axisymmetric convergent-divergent nozzle. The nozzle is operated underexpanded so that acceleration of the mixture to the required high Mach number is realized in the open jet. Combustion occurs downstream of the normal shock wave that exists in such underexpanded jets. The experimental facility which evolved for these studies is described.

Experiments are described wherein stationary shock wave-combustion configurations were realized. These experiments covered the mixture stagnation temperature range of about 1800°R-2430°R and a wide fuel-air range. In all cases of interest the shock wave and flame were separated by a distance corresponding to the mixture ignition delay time. This delay time varied from 10-50 μ secs, the shorter times occurring with higher temperatures. At lower temperatures, where the separation between shock and flame is greater, there was no apparent interaction between the shock wave and flame. At higher temperatures the onset of combustion was observed to drive the shock wave upstream to a new stable position wherein the Mach number into the shock was lower. This latter type is considered to be a standing detonation wave.

A theoretical analysis of the ignition delay zone of hydrogen-oxygen combustion is presented. Nine reactions are considered but the order of magnitude of many of the terms allows the reaction scheme to be considerably simplified. As a result it is possible to predict the rate of growth of all radical and water vapor concentrations behind the shock. Particular attention is given to the time variation of the hydrogen atom concentration. In order to arrive at an explicit analytical expression for the ignition delay time, a value for the mole fraction of hydrogen atoms, characteristic of this delay time, is introduced. It is found that the delay time is dependent on the temperature, pressure, and composition of the mixture behind the shock as well as the pertinent reaction rate constants. The rate controlling reaction is that of $O_2 + H \rightarrow OH + O$. These theoretical predictions are compared with the experimental results obtained and very good agreement shown. The results, both theoretical and experimental,

are in contrast to the findings of Gross who observed no ignition delay zone in similar experiments with hydrogen and air.

The main results of this study are:

- 1) standing detonation waves have been successfully generated. Such waves offer many advantages to the study of combustion processes and represent a possible mode of combustion in hypersonic ramjets.
- 2) a new experimental technique for the study of ignition time delays of gaseous mixtures at high temperatures has evolved. Other applications to chemical kinetic problems are possible.
- 3) a theoretical prediction of ignition time delay of hydrogen-oxygen mixtures is presented which is consistent with the experimental results of this investigation as well as those of other investigations.

Microfilm \$2.50; Xerox \$7.80. 166 pages.

ENGINEERING, CHEMICAL

A LIGHT SCATTERING STUDY OF UNFRACTIONATED POLYVINYL ACETATE: MOLECULAR CHANGES FOLLOWING VARIATIONS IN THE SOLVENT SYSTEM.

(L. C. Card No. Mic 60-2504)

Richard Allen Ahlbeck, Ph.D.
University of Michigan, 1960

The purpose of this study was to apply the light scattering technique and intrinsic viscosity measurements to determine the molecular characteristics of unfractionated polyvinyl acetate in dilute solutions. The problem is of practical significance to industrial research since it has proven necessary to evaluate many unfractionated polymers but uneconomical to fractionate all polymers for precise study.

The sample of polyvinyl acetate used here was prepared by bulk polymerization at -23°C to 27% conversion. These conditions were chosen to eliminate branching. This polymer of high molecular weight was dissolved in methyl isopropyl ketone for the initial light scattering study. Subsequent measurements combined "MIPK" with a second isorefractive liquid--normal heptane--in various concentrations of a binary solution. Finally, intrinsic viscosity measurements provided a convenient check of the molecular behavior of polyvinyl acetate at the extremes

of solvent composition; this also permitted comparison with an earlier study of the same polymer fractionated.

Essentially, this study indicated that molecular association of polyvinyl acetate does occur, and that the association increases directly with the heptane content of the solvent. Noted as the solvent became poorer were increases in the weight-average molecular weight (M_w), the number-average molecular weight (M_n), and the ratio of weight-average to number-average molecular weights. M_w , which is sensitive to the presence of molecules of high molecular weight, increased from 1.0 to 1.6 million. M_n , which responds to the presence of low-molecular-weight molecules, increased from 0.3 to 0.39 million.

Under the conditions of this light scattering study it was possible to determine the "light scattering" average size of the polymer molecule. This size, often incorrectly referred to as the z ("zed") average size, is really the end-to-end distance or radius of gyration of a chain having a " z " average molecular weight. The " z " average molecular weight involves a higher moment of the mass of the polymer molecules and thus is a better indicator of the presence of high-molecular-weight polymers than the weight-average molecular weight. In this study there was some evidence that the z -average radius of gyration exhibited a maximum as the solvent power decreased at finite polymer concentrations. On the basis of dilute solution theory, association would be indicated. The existence of a maximum would be in qualitative agreement with the recent statistical-thermodynamic theory of W. R. Krigbaum, relating the size of random coil molecules to molecular weight, solvent power, and polymer concentration.

Since both the number-average size and the molecular weight are experimentally determinable, the determination of an effective bond length which is independent of the molecular-weight distribution is possible. The effective bond length decreased from 10 Å to 5 Å just above the polymer precipitation point. The second virial coefficient of polyvinyl acetate in methyl isopropyl ketone at 32°C was found to be $3.3 \times 10^{-4} \text{ cm}^3 \text{ g}^{-2} \text{ mole}$. The intrinsic viscosity under the same conditions was $303 \text{ cm}^3 \text{ g}^{-1}$. Slightly above the phase-separation point, the intrinsic viscosity was $100 \text{ cm}^3 \text{ g}^{-1}$. These values are in reasonable agreement with those obtained by A. R. Shultz using fractionated polyvinyl acetate.

It is concluded that: (1) Molecular association does occur in the system unfractionated polyvinyl acetate-methyl isopropyl ketone-normal heptane and that it increases as phase separation is approached. (2) An approximation of the effective bond length has been obtained without fractionation. Since the conclusion of this work, evidence* has been accumulated which suggests an increase in the syndiotacticity of polyvinyl acetate produced under the low-temperature, free-radical conditions of this study. Studies which it is hoped will follow may show that this is the key factor behind the observed association.

Microfilm \$2.50; Xerox \$8.80. 192 pages.

*Discussed in some detail at the Gordon Research Conference on Polymers, 1958.

THE CORRELATION OF BINARY AND TERNARY LIQUID-LIQUID EQUILIBRIA

(L. C. Card No. Mic 60-2509)

Thomas Cox Boberg, Ph.D.
University of Michigan, 1960

This dissertation investigates the correlation of liquid-liquid phase equilibria with primary emphasis on the interrelations between binary and ternary systems. A correlation framework of the Redlich-Kister equations relating activity coefficients to composition was used. The complexity of the equations led to the extensive use of high speed digital computing techniques.

The Redlich-Kister equations are based on an empirical representation of the thermodynamic function, the molar excess free energy of mixing, ΔG^E , which for the case of a two component system may be written:

$$Q_{ij} = \frac{\Delta G^E}{2.303RT} = x_i x_j (B_{ij} + C_{ij}(x_i - x_j) + D_{ij}(x_i - x_j)^2 + \dots)$$

where x_i , x_j , are the mole fractions of components i , j respectively and B_{ij} , C_{ij} , D_{ij} , ... are parameters known as binary coefficients. For a ternary system i - j - k , Q_{ijk} is represented:

$$Q_{ijk} = Q_{ij} + Q_{jk} + Q_{ki}$$

It was found that the equations retaining only the B and C binary coefficients are capable of representing most cases of ternary liquid-liquid equilibria of engineering importance. Systems having one partially miscible binary system are better fitted than systems having two binaries with miscibility gaps; systems having small miscibility gaps are better fitted than those with large regions of immiscibility.

Experimental data for a series of systems i - j - k_1 , i - j - k_2 , ... i - j - k_n where k_1 , k_2 , ... k_n are homologs may be used to predict the equilibria for a system i - j - k_i which has not been determined experimentally. B and C binary coefficients determined from experimental data were found to be simple functions of the boiling point of component k , enabling prediction of the coefficients for undetermined systems in the series. Since numerous homologous series of experimentally determined systems exist in the literature, this method is a powerful means of extending existing data. Four series of systems were used to demonstrate this correlation: water-ethyl acetate-alcohols, water-benzene-alcohols, n -paraffins-sulfur dioxide-benzene and n -paraffins-water-methanol, a total of twenty-two systems.

Equations enabling prediction of critical points (i.e. plait points) were developed and presented for the case of the Redlich-Kister equations. Given numerical values for coefficients, the critical equations enable one to tell whether or not a given system will be partially miscible, and if it is partially miscible, what the location of critical points (if any) will be.

It was found that coefficients determined from binary data frequently do not predict ternary data accurately.

A review of phase diagrams for liquid-liquid systems is given, and the thermodynamic basis of the equations is presented. Particular attention is given to free energy-composition diagrams and the derivation of relations

pertaining to phase stability and critical phases. The effect of temperature on activity coefficients is also reviewed briefly.

Least squares curve fitting is discussed in detail as applied to the ternary Redlich-Kister equations where it is required to obtain best estimates of equations coefficients. Since in the case of ternary liquid-liquid equilibria one is dealing with three simultaneous equations non-linear in equation coefficients and implicit in dependent variables, the computational problem is considerable. The method of steepest descent was used supplemented by a method based on expansion of the dependent variables by Taylor series truncated after linear terms. In the steepest descent method successively better estimates of equation coefficients are obtained by making corrections proportional to the partial derivatives with respect to the coefficients of the sum of the squares of the deviations of predicted values of the dependent variables. In the Taylor series method linear equations readily solvable for corrections to equations coefficients are obtained.

Microfilm \$2.60; Xerox \$9.00. 200 pages.

LIGHT SCATTERING IN DENSE DISPERSIONS OF SPHERICAL PARTICLES

(L. C. Card No. Mic 60-2516)

George Charles Clark, Ph.D.
University of Michigan, 1960

The effect of particle separation distance on the light scattering properties of a dispersion of spherical particles was investigated experimentally. The experimental equipment which was used for this study consisted of a collimated monochromatic light source, a cell to contain the dispersion, and a wide angle receiver. The light sensing device which was used in the receiver was a photomultiplier. The cell was designed with absorbing parallel-plane boundaries and variable thickness. The transmission of the dispersion was continuously recorded as a function of the cell thickness. This recording was made for several particle concentrations to determine the effect of the distance between particles upon the light transmission. In the experimental study the average particle separation distance (center to center) was varied from about 2.3 to 6 particle radii. The optical thickness of these dispersions expressed in mean free paths for scattering was varied from about 50 to 5000. Particle diameters of 0.814 and 1.171 microns were used in this experimental investigation.

Several theoretical techniques for the calculation of the energy transmitted by a dispersion were also examined. If the scattering process is represented by a model of infinite lateral dimensions in which the flux of energy is arbitrarily limited to the forward and backward direction, it is possible to derive two differential equations which describe the transport of energy in the dispersions. A term was added to these differential equations to allow for a sideways divergence of energy within the dispersion. It is necessary to incorporate this term in the equations to represent the finite dimensions of the equipment. These differential equations were solved, and this solution was used to represent the variation of the transmission of the dispersion with physical thickness. The constants which

were obtained in this two-flux solution were determined by fitting the experimental data to the theoretical equation using a nonlinear least-squares technique. An effect of the particle separation distance on the scattering properties of a dispersion would be reflected in a change of these constants.

The two-flux solution showed a remarkable ability to describe the transmissions which were determined experimentally. The standard deviation of more than 300 experimental points from the theoretical curves was less than 1.5 per cent. Within the range of variables considered in this investigation there is no consistent trend of variation of the backward scattering coefficient predicted from the regression of the experimental data on the two-flux solution. The backward scattering coefficient which was calculated scatters over a range of about ± 7 per cent of the average value. This study indicated that there is no significant effect of the particle concentration on the transmission of a dispersion within the range of variables considered. The results of this investigation confirm the feasibility of scaling dilute natural dispersions, such as clouds with dimensions of miles, down to dense dispersions with dimensions in the order of inches for laboratory study. Microfilm \$2.55; Xerox \$8.80. 193 pages.

A STUDY OF THE IRRADIATION METHOD IN THE MEASUREMENT OF MOLECULAR WEIGHT DISTRIBUTION IN POLYSTYRENE

(L. C. Card No. Mic 60-2534)

William Walter Graessley, Ph.D.
University of Michigan, 1960

The object of this investigation was to study the radiation crosslinking-solubility characteristics of polystyrene. The purpose was to determine whether properties of the molecular weight or size distribution of a polymeric system could be measured experimentally from its subsequent crosslinking-solubility behavior.

A series of samples of polystyrene, composed of linear chains and completely soluble in a wide range of organic solvents, was used, ranging in weight-average molecular weight, \bar{M}_w , from about 1,000,000 to 5,000,000; in number-average molecular weight, \bar{M}_n , from about 300,000 to 3,000,000; in z -average molecular weight, \bar{M}_z , from about 1,600,000 to 7,500,000; and with distribution breadth ranging from very narrow ($\bar{M}_w/\bar{M}_n = 1.06$) to fairly broad ($\bar{M}_w/\bar{M}_n = 3.7$). Each sample was caused to undergo crosslinking, along with chain scission to a lesser extent, by irradiation in vacuum using Cobalt-60 gamma radiation for various total doses, and the resulting solubility for each dosage was determined by solvent extraction of the partially gelled solid films. From existing theories of random crosslinking and chain scission, equations were developed, relating the measurable properties of gel curves (weight fraction soluble as a function of radiation dose) to the initial molecular weight distribution of the sample, and two properties of the distribution (\bar{M}_w/\bar{M}_n and \bar{M}_z/\bar{M}_w) were computed for each sample.

From the dependence of gel point dosage upon \bar{M}_w , it was concluded that crosslinking density is proportional to radiation dose. Likewise, chain scission density is proportional to radiation dose, as shown by the constancy of the chain scission parameter (chain scissions per cross-linked unit) from sample to sample, and the ability of a single value of this parameter to fit over the entire dose range in samples with most-probable distribution ($\bar{M}_w/\bar{M}_n = 2$).

The gel curves themselves were reproducible and were experimentally accurate enough to allow unambiguous measurement of the quantities required for the computation of \bar{M}_w/\bar{M}_n and \bar{M}_z/\bar{M}_w . With few exceptions, the values of \bar{M}_w/\bar{M}_n and \bar{M}_z/\bar{M}_w obtained from the gel curves were in good agreement with those obtained from light scattering measurements, ultracentrifuge-sedimentation studies, and by the known compositional makeup of the samples.

Subsidiary tests indicate that 1) oxygen has a considerable effect on apparent crosslinking behavior, 2) such variables as radiation dose rate (over a range of nine) and film thickness (over a range of two) produce no effect on the results, 3) extraction solvents, such as benzene, toluene, and cyclohexane, give identical solubility results, but methyl ethyl ketone gives higher and unstable solubilities, and 4) pre-irradiation conditioning, such as film-casting solvent used, can produce a considerable effect on apparent crosslinking behavior.

An anomalous solubility behavior in the vicinity of the gel point is noted, indicating a discrepancy between gel point dosage deduced from extrapolation of the main body of the gel curve to 100% solubility on the one hand, and the minimum dose at which insolubility first occurs on the other. This may account for the high value of crosslinking efficiency derived from gel point measurements in this study using the former criterion (1700 electron volts per crosslinked unit), and those of some other investigators using the latter criterion (850-1100 e.v.).

Two conclusions can be drawn from the results: 1) for polystyrene, the basic assumptions of statistically random crosslinking and chain scission are well met in the range of chain lengths covered, and 2) the resulting gel structures are stable and reproducible enough to allow accurate computation of the distribution parameters desired.

Microfilm \$2.50; Xerox \$7.60. 162 pages.

THE USE OF STRONG SHOCK WAVES IN THE THERMAL DECOMPOSITION OF ETHANE AND ETHYLENE

(L. C. Card No. Mic 60-2594)

Irving Franklin Miller, Ph.D.
University of Michigan, 1960

A chemical shock tube was utilized to measure the rate of thermal decomposition of ethane to form ethylene and hydrogen and the rate of thermal decomposition of ethylene to form acetylene and hydrogen at high temperatures. The chemical shock tube is an instrument for producing, confining, and controlling shock waves. The reactant gas mixture is rapidly compressed and heated by the shock wave and then rapidly expanded and cooled by a

rarefaction wave. In its simplest form, the shock tube consists of two chambers separated by a thin diaphragm. One section contains a driver gas at high pressure while the other contains the reactant gas at a low pressure. When the diaphragm is suddenly ruptured, the movement of the high pressure gas into the low pressure section causes a shock wave to propagate through the low pressure section. The mixture is quenched by a rarefaction wave reflected from the end of the high pressure section.

The temperature and pressure history in the shock tube is computed from the measured wave velocity, along with the initial conditions of the driver and reactant gases. If a reaction mechanism is postulated, a reaction rate constant can then be computed from the composition of the final mixture in the tube. When a first order mechanism is postulated, the computed rates obtained in this investigation at temperatures between about 2200°R and about 5000°R indicate a lower apparent energy of activation than previous data obtained at lower temperatures (less than 2000°R) in conventional reactors. However, the data obtained in this investigation along with the data obtained by previous investigations with both shock tubes and conventional reactors can be represented grossly by a single apparent energy of activation over the extreme range of temperatures from 1300°R to 5000°R. These data represent degrees of conversion of up to about 60% ethane converted to ethylene and up to 17% ethylene converted to acetylene. The reaction rate constants which fit all the data are, for ethane to ethylene and hydrogen,

$$\ln k_1 = 19.365 - \frac{41640}{T}$$

and for ethylene to acetylene and hydrogen,

$$\ln k_1 = 10.756 - \frac{18940}{T}$$

where k_1 is the first order rate constant (sec.^{-1}) and T is temperature (°R). These equations give apparent endothermic energies of activation, for ethane to ethylene and hydrogen, of 83,000 BTU/lb.-mole (46 kcal/gm.-mole), and for ethylene to acetylene and hydrogen, of 37,700 BTU/lb.-mole (21 kcal/gm.-mole). In previous investigations of the cracking of ethane and ethylene, a whole spectrum of products of decomposition was obtained, while in this research, only the principal products of decomposition (H_2 , C_2H_4 , C_2H_2) were obtained. This difference is undoubtedly attributable to the shorter residence times and hence lower conversions obtained in this research.

Additions of O_2 , Air, CO and Cl_2 in amounts of less than about 10% did not affect the reaction rates significantly. Carbon was not included in the analysis. However, hydrogen and carbon balances for the gaseous products and reactants indicate that a slight amount of carbon is formed in the ethylene to acetylene reaction, but little or no carbon is formed during the ethane to ethylene reaction.

A significant percentage of acetylene can be made directly from ethane at the high temperatures achieved in a shock tube (4700°R and higher) and this reaction may have commercial possibilities. With the possibility of commercial applications in mind, a method for duplication of the conditions in the shock tube on a continuous basis was investigated theoretically. The system which was postulated was a convergent-divergent nozzle with a standing shock wave at the exit. The rate at which energy

would have to be transferred through the wall of the nozzle to the high velocity gas stream is extremely and perhaps prohibitively high.

Microfilm \$2.50; Xerox \$6.20. 128 pages.

**DIFFUSION OF GLYCEROL AND
SODIUM CHLORIDE IN RESINS AND ANALYSIS
OF ION EXCLUSION AND OTHER SOLID-LIQUID
MASS TRANSFER PROCESSES**

(L. C. Card No. Mic 60-2578)

Muhammad Tayyabji Tayyabkhan, Ph.D.
University of Michigan, 1960

The experimental study reported in Part I indicated that diffusion according to Fick's Law is an adequate model for describing mass transfer of NaCl and glycerol in the solid phase Dowex 50. Several baskets, each containing one gram of uniform resin particles, were first saturated with a solution and then subjected for different amounts of time to a stream of distilled water that carried away the solutes diffusing out of the resin. The solutes remaining in the resin were extracted and their amounts were determined. Amounts absorbed at equilibrium and diffusivities were determined by making a two constant fit of the data to a "diffusion model."

The variables studied were: (1) Resin Cross-Linkage - 2% to 12% divinyl benzene (abbreviated DVB); (2) Temperature - 25 to 80°C; (3) Concentrations in the Equilibrating Solution; (4) Resin Particle Size; (5) Flow Rate of the Eluting Distilled Water. Diffusivities increase with decrease in cross-linkage and with increase in temperature. The ratio of the diffusivities of NaCl or glycerol in the resin to that in water is between 0.2 and 0.35 for 2% DVB and between 0.025 and 0.1 for 12% DVB. Diffusivities were found to be independent of the variables 3, 4 and 5 above. The amounts of solutes absorbed at equilibrium also increased with a decrease in cross-linkage and an increase in temperature.

The analytic solution of the "diffusion model" is in the form of an infinite series that does not converge rapidly. A method of curve fitting by super-positioning a master plot has been developed for making a two constant fit of the data to the analytic solution. Besides being rapid, the method of super-positioning has the advantage of having less bias than many alternative methods.

In Part II eleven mathematical models of mass transfer processes in which a liquid is passed over a fixed bed of solid particles are discussed in increasing order of complexity. The effect of swelling and shrinkage of the solid with change in concentration and the effect of interdependent equilibria for solutes producing concentration and dilution effects are considered.

For each model x-t contour diagrams illustrate the relation between operating and system variables (i.e., values of parameters in the model) and the prominent characteristics of effluent curves (such as symmetry and skewness, sharp and training edges, peak position, etc.). The solution of a complex model may be estimated graphically from the solution of simpler models with the help of x-t contour diagrams.

Data available in literature on an ion exclusion column

operation with the system ethylene glycol-water-Dowex 50 were reproduced within estimated experimental error by a model assuming linear equilibrium and "diffusion" in the solid phase as the controlling mass transfer resistance. Diffusivities of ethylene glycol in Dowex 50 obtained from "fitting" the data to the model are 2.1, 1.9, 1.3 and 0.35×10^{-6} cm²/sec for the resin with 2, 4, 8 and 24% DVB respectively.

For the system glycerol-NaCl-water-Dowex 50, typical data curves from literature were analyzed by considering several models in order of increasing complexity, where each successive complicating mechanism was introduced from the considerations of the preceding model. The models considered had a limited success in reproducing the data. Microfilm \$4.00; Xerox \$13.95. 310 pages.

**THE EFFECTS OF POWER INPUT, AGITATION,
AND AIR FLOW ON THE RATE OF OXYGEN
TRANSFER IN FERMENTATION SYSTEMS.**

(L. C. Card No. Mic 60-2579)

George Tsu Ning Tsao, Ph.D.
University of Michigan, 1960

Rates of oxygen transfer were studied in three selected systems, namely: *Pseudomonas ovalis* and *Penicillium chrysogenum* respiration, and sulfite oxidation. The effects of power input, agitation, air flow, and liquid expansion on the rate of oxygen transfer were investigated in detail. An understanding of the effects of these variables is important for evaluation of oxygen transport in submerged fermentations. Also, the information should be of value for further studies such as those concerning the mechanisms of mass transfer in biological systems, reaction kinetics of growing cells, as well as process design and scaling-up of industrial fermentations.

The rate of oxygen transfer in actual fermentation broths of *P. ovalis* and *P. chrysogenum* were determined by a biological method developed in this study. For this method a known quantitative relationship between a metabolic product and oxygen consumption is required. In the *Pseudomonas* system, the rate of oxygen transfer was calculated from the rate at which gluconic acid was produced by the organism: in like manner, the carbon dioxide content of exhaust gas from the *Penicillium* fermentation was measured with an infra-red spectrophotometer. This enabled the rate of oxygen transfer to be calculated in each instance.

In the present work, oxygen transport study was facilitated by a procedure that was designated as the short-period technique. This involved use of aliquots of actually fermenting broths taken from another fermentor, or of resting cells prepared in buffered solutions. Use of this technique greatly accelerated the study.

Several empirical equations were developed by dimensional analysis. The effects of power input, agitation, air flow, and liquid expansion on the rate of oxygen transfer were examined by correlating the experimental results with the empirical equations. These equations have the following general form:

$$K_A = k_1 P^{k_2} G^{k_3} E^{k_4}$$

Correlation of oxygen transfer, including a factor of liquid expansion such as E , have not been previously reported in the literature. The importance of this factor was demonstrated by successful mathematical correlation of data taken in this study as well as that taken from several published articles.

In actual fermentations, the rate of oxygen transfer can be controlled by resistance at either the gas-liquid or the liquid-cell wall interface. This was studied in the *Pseudomonas* system where a linear relation was found to exist between the rate of gluconic acid production and the cell concentration of the broth. This suggested that the over-all oxygen transfer could be controlled by the resistance at the liquid-cell wall interface.

Microfilm \$2.50; Xerox \$5.20. 101 pages.

STUDY OF UNSTEADY STATE BEHAVIOR OF GAS STORAGE RESERVOIR ON ELECTRONIC DIFFERENTIAL ANALYZER

(L. C. Card No. Mic 60-2590)

Hyungduk D. Yoo, Ph.D.
University of Michigan, 1960

The purposes of this study are to develop a gas storage aquifer simulation method on an electronic differential analyzer to handle any arbitrary terminal reservoir conditions and to improve the understanding of the unsteady state behavior of an aquifer using the developed method as a tool, whenever needed. From the simulation, the reservoir volume change or the reservoir pressure change is to be obtained. The importance of such study arises from the standpoint of safeguarding the gas storage operation and for the interpretation of the reservoir engineering data. This study has common interest to both underground gas storage and oil production research.

In the first part, the analog simulation method on an electronic differential analyzer is presented. The simulation is essentially equivalent to the continuous computation of a convolution integral. From the mathematical constant terminal case solution based on a theoretical model study, a proper transfer function is set up on an electronic differential analyzer to obtain the desired solution by feeding in the specified reservoir terminal conditions as an input signal. The specification of the reservoir terminal conditions may be the reservoir pressure, the pore volume or the water flux. The results of the developed method are compared, for the basic cases, with the theoretical solution.

In the second part, the developed method is used as a tool for the theoretical aquifer behavior study. The study is categorized into the isolated fields, the effect of a fault on the unit step responses, the interference among two or more fields on a common aquifer and the moving boundary problems.

In the third part, the analysis of reservoir variables and a theoretical correlation method for aquifer gas storage field are presented. The correlation method is based on the analysis of the unit impulse response characteristic of the reservoir system. Other possible uses of an electronic differential analyzer for reservoir engineering problems are given. The applications to

other chemical engineering transient problems of linear characteristics are also discussed.

The following general conclusions can be drawn from the study:

- 1) The developed analog simulation method of an aquifer on an electronic differential analyzer is an excellent method to study the transient behavior of an underground gas storage reservoir. It operates continuously, quickly, and economically. The accuracy is well within the range usually required for typical gas storage operations.
- 2) The results obtained, based on the theoretical model study for various cases encountered in the gas storage operations, are given in figures and tables to improve the understanding of aquifer behavior.
- 3) Because of the difficulties involved in the mathematical formulation of the actual problems, and the large number of reservoir variables, there is no reason why one should stick to the model concept based on a series of assumptions. The model study can only be a guide to select a reasonable unit step response curve of a reservoir system.
- 4) The developed analog simulation method can be applied to any other physical linear system to analyze its transient behavior. In most reservoir problems, the pseudo-linearity assumption of the system response seems valid. Microfilm \$2.50; Xerox \$8.00. 172 pages.

ENGINEERING, CIVIL

FORCED VIBRATION OF TALL BUILDING FRAMES

(L. C. Card No. Mic 60-2230)

Za Lee Moh, Ph.D.
Purdue University, 1960

Major Professor: Dr. John E. Goldberg

This thesis is concerned primarily with the dynamic behavior and response of building frames to earthquakes. Linear viscous damping is assumed and the coupling effects of the damping terms in the analysis of damped structural systems are studied. The influences of the higher modes in the dynamic response of a building to earthquakes are also studied.

An approximate method, obtained by omitting the cross damping terms in the equations of motion, is studied. This method is based on the assumption that all the cross damping terms are small and can be neglected. The equations of motion become uncoupled relative to each other by the elimination of the cross damping terms. Each of the equations can be solved independently. This method greatly simplifies the mathematical operations. Through comparison of the numerical results obtained by the approximate method with results obtained by the exact method for a typical three-story building frame, it can be concluded that the approximate method will produce a fairly accurate result for structural design purposes.

In his book of *Theory of Sound*, Lord Rayleigh outlined

an approximate procedure to solve the many-degree-of-freedom vibration problem. By neglecting the cross damping terms in the set of equations of motion, the equations of motion become uncoupled. A first approximation is obtained by assuming that the mode magnitude varies approximately as if there were no change due to friction in this type of vibration. More refined approximations can be obtained by an iterative process. This approximate procedure is also studied. For a freely vibrating system starting in the first mode, Rayleigh's approximate procedure yields a good result in the first approximation. For free vibration system starting in the higher modes, the approximate procedure gives an erroneous result even when the second approximation is made.

A three-story rectilinear frame consisting of integrally connected columns and girders but without diagonal bracing is used as an example. The El Centro earthquake of 1940 is taken as a typical disturbance and the response of the three story frame is obtained through the use of the accelerogram of this earthquake.

Generalized coordinates, normal modes and unit step functions are used in conjunction with the superposition integral. The numerical results are computed with the aid of an I.B.M. 650 electronic computer and are presented graphically. Microfilm \$2.85; Xerox \$9.90. 219 pages.

ENGINEERING, ELECTRICAL

MODULATION CHARACTERISTICS OF O-TYPE ELECTRON-STREAM DEVICES

(L. C. Card No. Mic 60-2570)

Harold Sobol, Ph.D.
University of Michigan, 1960

The purpose of this dissertation is to present a general study of the modulated O-type electron-stream device. The modulations are classified according to the frequency of the modulating signal. Low modulation frequencies are very much less than the carrier frequency, while high modulation frequencies are comparable in rate to the carrier frequency. In order to simplify the analysis, the low- and high-frequency cases are investigated separately.

The O-type device undergoing a low-frequency beam modulation is described by a set of quasi-static functions. These functions are found by standard linear methods when the carrier is a low-level signal. The analysis includes modulation effects on C, QC, b, and d, as well as the initial wave amplitudes, and is valid for large modulation amplitudes. The device with a large-signal carrier is investigated using the nonlinear Lagrangian formulation. The modulation characteristics are used to calculate the output spectra when modulating signals having specific wave shapes are applied.

The significant results of the low-frequency study for the traveling-wave amplifier and the crestatron are:

A. Traveling-wave amplifier

1. An approximately linear phase modulation with a large accompanying amplitude modulation can be

produced by varying the beam potential. The phase linearity and phase-modulation index are almost independent of the carrier level and in some cases tend to improve as the carrier signal is increased to the saturation level.

2. Amplitude modulation with a small degree of accompanying phase modulation can be produced by varying the beam current. The amplitude-modulation index decreases as the carrier signal is increased from the small- to the large-signal levels.
3. It is important to consider modulation effects on the initial loss parameter A in the voltage-modulated, high-C amplifier.
4. Space charge decreases the phase modulation and increases the amplitude modulation in the voltage-modulated amplifier, while it decreases the amplitude modulation and increases the phase modulation in the current-modulated amplifier.
5. Loss increases the phase modulation and decreases the amplitude modulation for both voltage and current modulations.

B. Crestatron

Current or voltage modulation produces a linear (in db) amplitude variation with a small accompanying phase modulation.

An analysis of the high-frequency case is also given. The nonlinearities are introduced through the ballistic equations; however, an Eulerian analysis is used. The longitudinal-beam parametric amplifier is studied as a special case of the high-frequency problem. The first upper and lower sidebands around the pump signal are included, whereas in previous theories only the lower sideband was considered.

It is found that the gain in db for this "multifrequency" model is approximately one-half of the value obtained using the earlier model. The upper sideband is very heavily excited, indicating that noise will be carried at this frequency. The threshold pump signal required to produce gain with a finite diameter beam is greater than the signal required in the single-sideband case. The results obtained by using this model are more closely correlated with experimental data than the results obtained from previous theories. Therefore it can be concluded that it is necessary to consider at least two sidebands and probably more when analyzing the longitudinal-beam parametric amplifier.

Microfilm \$3.35; Xerox \$11.70. 258 pages.

ENGINEERING, MECHANICAL

A STUDY OF POOL BOILING
IN AN ACCELERATING SYSTEM

(L. C. Card No. Mic 60-2552)

Herman Merte, Jr., Ph.D.
University of Michigan, 1960

A study was made of the influence of system acceleration (1 to 21 g's) on pool boiling heat transfer in saturated distilled water at approximately atmospheric pressure. To the author's knowledge, this is the first study made of heat transfer by boiling in the presence of a force field greater than that due to standard gravity.

A flat electrically heated chromium plated copper disc serves as the heat transfer area, with a thin stainless steel skirt attached to the periphery of the disc to provide a continuous surface. The water depth is maintained constant at 2 1/2 inches, and a cooling coil on the underside of the cover condenses the vapor formed. Temperatures in the heating disc and water are measured with an uncertainty of $\pm 0.1^\circ \text{F}$.

Acceleration is attained by use of the centrifuge principle. The boiling system is pivoted from the cross arm on a vertical shaft such that the acceleration is always normal to the heating surface. The magnitude of the acceleration is varied from that due to one standard gravity up to 21 times gravitational acceleration.

Heat flux rate is varied from approximately 5,000 to 100,000 Btu/hr-ft².

Several tests were conducted with non-boiling convective heat transfer. The data agreed quite well with the correlation:

$$\text{Nu} = 0.14 (G_r P_r)^{1/3}$$

With boiling at heat flux values up to 50,000 Btu/hr-ft², it was found that a small degree of subcooling significantly influenced the results with the system under acceleration. Data are presented showing the influence of subcooling for heat fluxes of 10,000 and 25,000 Btu/hr-ft² and for various accelerations.

With boiling to essentially saturated water, the difference between the heating surface temperature T_w , and the water saturation temperature T_{sat} decreases with an increase in acceleration at lower values of heat flux. As the heat flux level increases, the decrease in $T_w - T_{\text{sat}}$ becomes smaller, and at the higher values of heat flux $T_w - T_{\text{sat}}$ increases with an increase in acceleration. The decrease in $T_w - T_{\text{sat}}$ at low values of heat flux is attributed to the increased contribution of natural convection with acceleration. At higher values of heat flux the effect of natural convection is relatively smaller. It is believed that the action of acceleration results in smaller bubble sizes at departure, with an attendant decrease in agitation. For a given total heat flux more nucleating sites are required, which in turn require the observed higher wall temperatures.

As a means for obtaining a theoretical understanding of the process of boiling under the influence of high acceleration including the simultaneous effect of natural convection, a concept of the "Area of Influence" of the bubbles is defined and values calculated for the various accelerations and heat flux rates.

The change in $T_w - T_{\text{sat}}$ with heat flux and acceleration is used to calculate the influence of heat flux on the number of active nucleating sites.

Microfilm \$2.50; Xerox \$8.40. 183 pages.

ENGINEERING MECHANICS

ON DYNAMIC PROBLEMS OF
SHALLOW SPHERICAL SHELLS

(L. C. Card No. Mic 60-2542)

Arturs Kalnins, Ph.D.
University of Michigan, 1960

Except for the simplest of shell configurations, such as cylindrical shells, the treatment of dynamic problems of shells has been limited in scope and confined even in special cases to energy and similar approximate methods. Recently, the general problem of elastokinetics in the theory of shallow shells was shown to be characterized by a system of differential equations in terms of one of the middle surface displacements and a stress function; this system of equations is exact within the scope of the theory of shallow shells.

This dissertation is concerned with the axisymmetric vibrations of thin shallow elastic spherical shells. Utilizing the exact system of differential equations mentioned above, the general solution, within the scope of the linear theory, for harmonic motion is deduced and discussed in detail. In particular, exact solutions are obtained for (a) free axisymmetric vibrations of shallow spherical shell segments with various edge conditions, (b) the response to oscillating concentrated loads at the apex of unlimited shallow spherical shells.

Comparison is drawn between the above two exact solutions and the corresponding previously known approximate results for transverse (or axial) vibrations of shallow spherical shells. It is found that for free vibrations in the range of parameters selected the agreement between the exact and the approximate results, where the effect of longitudinal inertia is neglected, is remarkably good. On the other hand, the previously known solution of the forced oscillation problem of unlimited shallow spherical shells, where the longitudinal inertia is neglected, is seriously in error.

Microfilm \$2.50; Xerox \$4.40. 83 pages.

FINE ARTS

UKIYOE PAINTING, SELECTED PROBLEMS. (VOLUMES I AND II).

(L. C. Card No. Mic 60-2573)

Harold Phillip Stern, Ph.D.
University of Michigan, 1960

The Ukiyoe school is one of the major developments in the history of late Japanese Art. The prints that these artists produced are known; the paintings are not. This study seeks to remedy that matter. It traces the development of the paintings and discusses selected problems. The collection of ukiyoe in the Freer Gallery of Art, in particular, is singled out and examined. It is one of the two largest and most important collections. Its contents have never before been studied and made available to the scholar by publication.

In Chapter I, the term ukiyoe is defined as paintings of the current world, and the background history of Japanese painting leading up to it is presented. As a result, it was found that the ukiyoe is not a new form, but an Edo Period term given to the yamatoo tradition.

Chapter II discusses the Ashikaga revival and early years of ukiyoe.

Hishikawa Moronobu, the early Edo master, and his fol-

lowers and other founders, are the subjects of Chapter III. A self-portrait of Moronobu is fully published, and an unrecorded artist, Moroyasu, is examined for the first time.

The trend of development from Hanabusa Itchō up to Utamaro is the theme of Chapter IV. The patterns by which ukiyoe changed from complex and crowded to simple compositions are reported against a historical and biographical background of the artists of this school. The studios were created and the demand for ukiyoe multiplied. This eventually snuffed out the creative drive and led to the demise of the school.

Chapter V discusses Utamaro and establishes an often questioned painting by him as a major product of his brush.

Hokusai is the subject of Chapter VI. The first comprehensive examination and catalogue of the largest collection of his paintings in the world is presented.

Two artists, Toyokuni and Hiroshige, who gave the last elements of glory to ukiyoe before it passed into an eclipse, are the topic of Chapter VII.

The conclusion reached in contrast to former opinion shows ukiyoe to be but a revival of the yamatoo tradition. The course of its existence, the men who produced them, their position in the Japanese social structure and the products of their brushes, are all within the scope of this study. Microfilm \$6.55; Xerox \$23.40. 516 pages.

GEOGRAPHY

THE RURAL SETTLEMENT OF THE LOWER SAVANNAH RIVER BASIN IN GEORGIA

(L. C. Card No. Mic 60-2520)

Sherwin Harry Cooper, Ph.D.
University of Michigan, 1960

The dissertation is a study of the relationship between rural settlement and its physical, social, and economic milieu in the Lower Savannah River Basin in Georgia at various stages in its history. The first four chapters stake out broad periods of equilibrium between social forces, population, and the distribution of rural dwellings, with each period focusing on a different physical setting. The transitions from period to period are marked by upheavals of one sort or another which caused shifts in settlement. The fifth chapter is a detailed study of the relationship of settlement today to various types of land--with special reference to soils.

Field and library research consisted of: (1) the search for the boundaries and definitive features of the region; and (2) the collection of data on the form and distribution of rural settlement in each stage of occupancy. Three

types of boundaries--a physical, a cultural, and a functional--, were found to coexist within the region. The most clearly defined is the Savannah River and its flood plain, running the entire length of the Basin on one side. The remaining boundaries fall along the rural-urban fringes of Augusta and Savannah, and along traffic divides between rural areas. Settlement data were gathered from several sources. Foremost were the Colonial Records of the State of Georgia, U.S. censuses of agriculture and population, and maps and gazetteers dating from the earliest period of settlement to the present. Most of the field work involved in this phase of the study consisted of bringing the settlement map up to date.

Several major changes in rural settlement have taken place since the initial settlement by Europeans in 1733. Rice planting produced the first. It concentrated settlement along the river banks, and gave rise to the plantation system. The second major change followed the invention of the cotton gin in 1793. The uplands of the Basin, theretofore sparsely settled by the pioneer farmer, were suddenly transformed into a densely settled agricultural region. The plantation system was borrowed from the lowlands, and with it its peculiar form of settlement--the

plantation cluster or "village." A third great change came with the Civil War. The clusters of plantation settlement were broken up; the rice lowlands were largely abandoned; and dispersed individual houses became the dominant form of rural settlement. Numerous hamlets and villages appeared, with the newly introduced railroads providing the impetus. The dominance of the dispersed dwelling continues today, but it has been weakened by social and economic forces which have caused an over-all attrition of rural settlement in the Basin.

With changing conditions, lands which had been supporting substantial settlement lost their power to continue such support, while other lands, previously unused, became attractive. Institutional and economic changes have sometimes brought about total transformations of settlement upon lands which had apparently lost none of their fundamental properties. The Basin has always been agricultural, and in some instances land was simply abandoned when the crop to which it was best, or perhaps solely, adapted, lost its market. In most areas undergoing change, however, it was change in the form, pattern, density, or distribution of settlement, rather than the appearance or disappearance thereof.

A general conclusion drawn from the study is that the qualities of the land determine only the particulars of settlement, and are subordinate to socio-economic forces in controlling the over-all density and distribution thereof. If this is true, the rural Basin, which has been declining in population for several decades, has little hope of recovery as long as the broad social and economic conditions of today persist.

Microfilm \$3.20; Xerox \$11.25. 248 pages.

CHANGING PATTERNS OF AFRICAN LAND USE
IN SOUTHERN RHODESIA [WITH] ATLAS OF
MAPS, AIR AND GROUND PHOTOGRAPHS,
ILLUSTRATING DISSERTATION.

(L. C. Card No. Mic 60-2600)

Barry Neil Floyd, Ph.D.
Syracuse University, 1960

This dissertation describes and evaluates the changing patterns of native agriculture in Southern Rhodesia. It is particularly concerned with recording and analyzing new patterns of land use and settlement which are resulting from an ambitious program of tenurial change and improved farming practises in the African areas. The Southern Rhodesian land reform program was adopted in 1951, in the form of the Native Land Husbandry Act. Execution of the N.L.H.A. by means of a Five Year Plan (1956-1960) is under way; a second Plan will probably follow.

The need for widespread changes in African agriculture in Rhodesia is irrefutable. Increased pressures of a

growing population upon limited and deteriorating land resources have led to a parlous condition in the native rural areas.

Consideration is given to the physical and human facts of Southern Rhodesia and their broad bearing upon native agriculture. The history of land apportionment or the division of the country between Europeans and Africans is also reviewed.

Land use systems and settlement patterns in the native reserves prior to the N.L.H.A. are recreated and the Act itself examined. Each stage of its implementation in the field is described -- Preliminary Development and Initial Survey, Centralization, Conservation, Allocation of Arable and Grazing Rights -- with regional illustrations and maps based upon the writer's experiences as a Land Development Officer in the Provinces of Northern and Southern Mashonaland.

The concluding chapters attempt an evaluation of the N.L.H.A. Attention is given to the impact of the rural reforms upon traditional social structures and tribal tenure; also to the power of legislation in land development, rural-urban relationships and land apportionment. A reappraisal of territorial segregation is urged.

Outstanding problems in the arable and grazing areas are noted and the speed at which changes are occurring is questioned. Keeping the sandveld soils of Rhodesia under continual crop cultivation will require fertilizer treatments or ley farming techniques which are beyond the present abilities of the native farmer to adopt. To achieve correct carrying capacity in the grazing areas, a marked destocking of cattle and vigorous efforts at pasture improvement will be necessary. Hasty implementation of measures for reversing land degradation may result in inadequate planning and the creation of more serious land use problems in the future.

The recommendation is made that specialized cash cropping be developed, paying due attention to the range of environmental conditions which exists in the African areas of Southern Rhodesia, particularly in the Eastern Districts.

The promotion of group farming or co-operative action among African cultivators is advocated, supported by long-term capital investment from more advanced peoples and countries concerned with aiding the progress of under-developed areas.

The writer declares his faith in the N.L.H.A. as being the means of redeeming the agricultural life of the African reserves in Southern Rhodesia. The N.L.H.A. is not an outright panacea for all the ills of the African rural economy. It is, however, a stabilizing Act on a nationwide scale, creating a solid foundation upon which, through more detailed regional planning, it will be possible in the long run to establish a settled agricultural community, employing better farming methods, achieving greater productivity in crop yields and animal husbandry and thus improving material and cultural levels of living.

Microfilm \$10.35; Xerox \$36.85. 818 pages.

HEALTH SCIENCES

HEALTH SCIENCES, GENERAL

AN EVALUATION INSTRUMENT FOR THE SCHOOL HEALTH SERVICE PROGRAM

(L. C. Card No. Mic 60-2640)

Ray Watters, H.S.D.
Indiana University, 1960

Chairman: J. Keogh Rash

The purpose of this study was to (1) develop a valid, reliable and objective score card to measure the effectiveness of the health service program of the elementary and secondary school and (2) provide a functional instrument for locating particular areas of the program where improvement might be indicated.

Method of Procedure: Three sub-problems were used in developing the health service score card: (1) the derivation of health service criteria considered essential for an adequate program, (2) weighting of each criterion according to its contribution to the total health service program, and (3) establishing the validity and reliability of the score card.

Health service criteria were selected from current sources considered to be authoritative for school health service programs. These criteria were organized under seven major divisions and assembled on a rating scale to be sent to a national jury of health representatives. Each juror rated and accepted the criteria on a four point rating scale.

The criteria accepted by the jury were organized on a second rating scale and a weighted value assigned by the jury to each criterion on a percentage basis. From the mean percentage a numerical value was assigned each criterion.

Validity was established from the authoritative sources of the criteria and the acceptance by the national health jury. Reliability was determined by an initial and final survey conducted by a survey team to three public schools. The percentage of agreement between scorers on the initial and final survey was determined for each criterion. If any criterion had a 20 per cent disagreement it was revised or eliminated from the score card.

Two hundred and ten score card criteria were accepted as reliable by the jury. The health service score card, accepted and evaluated by the jury, is included in the appendix of the thesis.

Conclusions

1. The health service score card contains the recommended practices and procedures for an adequate school health service program as established by pertinent literature review and accepted by a national health service jury.

2. The health service score card is a valid and reliable survey instrument which can be used to determine

the status of existing health service programs as compared with recommended policies, practices and procedures.

3. The health service score card will provide, for administrators and school personnel, a basis for improvement of present health service programs by comparison of existing policies, practices and procedures with recommended policies, practices and procedures.

4. The application of the health service score card, with a sincere intent for improvement of the health services within a school, will direct attention of responsible individuals to the weaknesses and strengths of the program.

5. The school health service score card provides an instrument by which periodic evaluations can be made in order to improve the school health service program.

Microfilm \$4.25; Xerox \$14.85. 329 pages.

HEALTH SCIENCES, HYGIENE

THE USE OF HARMFUL HEALTH MISCONCEPTIONS AS A BASIS FOR THE SELECTION OF SUBJECT-MATTER AREAS, AND COURSE CONTENT IN COLLEGE HEALTH CLASSES

(L. C. Card No. Mic 59-6126)

Robert Joseph Synovitz, H.S.D.
Indiana University, 1959

Chairman: Dr. Bernard I. Loft

Purpose

The purpose of this study was to determine the amount and kind of harmful health misconceptions believed by the students in basic health information classes in four-year colleges in the state of Indiana, and whether they were affected by the factors of: age, grade level, sex, race, course background, rural or urban background, marital status, major area of academic preparation, school attended, geographic location, and religion. These beliefs were then used as a basis for the selection of subject-matter areas and course content in college health classes.

Procedures

The Borozne Health Information Opinionnaire, an instrument for determining beliefs in harmful health misconceptions, was selected and administered to students attending basic health information classes and enrolled in Indiana colleges. All colleges meeting the delimitations of this study and able to cooperate in this investigation were visited by the writer for the administration of the

testing program. This resulted in the compilation of the harmful health misconceptions believed by 630 students.

The analysis of these data were concerned with determining the percentage of harmful health misconceptions believed in each of seven subject-matter areas, the percentage of students who believed each of the harmful health misconceptions, and the significant differences that occurred between the mean harmful health misconception scores of students divided into groups according to age, grade level, sex, race, course background, rural or urban background, marital status, major area of academic preparation, school attended, geographic location, and religion.

Conclusions

Based on this investigation, and under the assumption that the students taking part in this study make up a random sample of a recurring population enrolled in Indiana colleges and attending basic health information classes, the writer makes the following conclusions:

1. Beliefs in harmful health misconceptions were prevalent among students enrolled in Indiana colleges and attending basic health information classes.
2. Strengths and weaknesses in health content and subject-matter areas can be determined by measuring beliefs in harmful health misconceptions.
3. Harmful health misconceptions believed by the students include content which appears to be desirable for inclusion in basic health information classes at the college level.
4. When planning course content, college teachers do not have to be concerned with the factors of age, in-state and out-of-state background, religion, rural or urban background, and school attended.

Recommendations

Based on this investigation, the writer makes the following recommendations:

1. Harmful health misconceptions should be used as a basis for selecting subject-matter areas and content to be used in basic health information classes at the college level.
2. The subject-matter areas of exercise, first aid, and personal hygiene should receive special emphasis in basic health information classes at the college level.
3. Special efforts should be made to remove harmful health misconceptions of all prospective teachers.
4. The greatest emphasis in basic college health instruction should occur at the freshman level.
5. There is a need for more qualitative studies in harmful health misconceptions involving various grade levels.
6. Studies in harmful health misconceptions should be conducted in other geographical locations.
7. Extensive studies should be conducted in the prevalence of harmful misconceptions occurring in safety education and driver education.
8. Instruments used to measure the prevalence of harmful health misconceptions should be revised

periodically to keep the concepts proposed consistent with current scientific facts.

Microfilm \$2.50; Xerox \$8.20. 177 pages.

HEALTH SCIENCES, PUBLIC HEALTH

RESONANCE RADIATION EFFECTS OF LOW ENERGY MONOCHROMATIC X-RAYS ON CATALASE

(L. C. Card No. Mic 60-2528)

Ardath Henry Emmons, Ph.D.
University of Michigan, 1960

This thesis investigation consisted of a study of the variation of the damage per photon absorbed in the enzyme catalase subjected to monochromatic x-rays in the energy range of 5 to 10 kev. X-rays of discrete energies were obtained by two different techniques. A number of studies were made using the x-rays from a crystal spectrometer. This technique provided energy resolutions of better than ± 0.3 kev. The second technique used a high-output beryllium window x-ray tube to obtain line spectra by fluorescence in selected target materials. The crystal spectrometer is a low output single-energy x-ray source, whereas the fluorescence generator provides a high output of discrete energies of x-rays.

The enzyme catalase was used as a test system. Catalase has a molecular weight of 225,000 and contains an essential trace of iron in a concentration of 0.09 percent by weight. This enzyme catalyzes the oxidation of hydrogen peroxide to water and oxygen. Catalase concentrations were determined with a Model DU Beckman Spectrophotometer, which was used to measure the rate of hydrogen peroxide oxidation; this rate is a function of the catalase concentration.

Samples of catalase solutions were irradiated with x-rays of energy 7.3 kev and 6.9 kev from the crystal spectrometer. Those x-rays of energy 7.3 kev, just above the iron k-absorption edge, were approximately three times more effective in damage production than the x-rays of 6.9 kev, just below the iron k-edge. Samples of catalase solutions were also irradiated with the emission line x-rays from targets of nickel, iron and manganese. The emission x-rays of nickel ($K_{\alpha} = 7.47$ kev) were approximately twice as effective in damage production per photon absorbed as the manganese emission x-rays ($K_{\alpha} = 5.89$ kev). The iron emission x-rays ($K_{\alpha} = 6.40$ kev) were seven times more effective than those of manganese.

Samples of dry catalase were irradiated with the fluorescent emission line x-rays from nickel, iron, manganese, and chromium targets. Those samples exposed to the emission x-rays from iron and manganese required an induction dose, which caused no measureable effect, prior to the onset of observable radiation damage. Those samples exposed to the emission x-rays of nickel and chromium suffered damage best represented by an exponential function characteristic of a "one-hit" model. However, when the dose range for observable damage was reached, using iron or manganese emission x-rays, the

rate of destruction was greater than that caused by nickel or chromium emission lines. For higher radiation doses, the total destruction caused by emission x-rays from iron and manganese exceeded that caused by x-rays from nickel and chromium.

This work has shown that there are marked variations in the damage, per absorbed photon, produced in catalase by monochromatic x-rays in the energy range of 5 to 10 kev. Microfilm \$2.50; Xerox \$6.00. 122 pages.

HISTORY

HISTORY, GENERAL

THE CHATHAM MINISTRY AND
THE AMERICAN COLONIES 1766-1768

(L. C. Card No. Mic 60-2555)

Lee Elmer Olm, Ph.D.
University of Michigan, 1960

The scope of this dissertation is a bit less limited than the title might suggest. The Chatham ministry is used as the focal point in this study of imperial conflict, because it seemed the most likely group of men to resolve those imperial problems peaceably. That the hopeful expectations failed to materialize intensifies the interest in the ministry and tends to surround the Chatham administration with an aura of mystery. The purpose of this study then is to examine the problems facing imperial relations in the decade of the 1760's and to suggest why the Chatham ministry, or any other ministry for that matter, failed to assuage the tensions.

For the purposes of this study, three major problems are considered topically and in separate chapters. Although the Mutiny Act for America could, with some justification, be included in the discussion of the taxation issue, the matter seemed so important in its own right, and the resources of the Gage Papers and other manuscript collections at the William L. Clements Library in Ann Arbor, Michigan, were so illuminating on this comparatively unknown and neglected imperial problem, that a separate and more intensive treatment was deemed advisable. The problems involved in the transmontane West are investigated in the concluding major chapter. Of course, none of the problems were solely the concern of the Chatham ministry, and therefore consideration is often extended to include a greater part of the decade. Except for the first chapter which deals with the Chatham ministry as part of British history, the bulk of this study is imperial in scope. It is hoped that the balance between things British and things colonial is judicious. Studies of this sort have a tendency to lean too far one way or the other. The thematic approach is intended to keep the study truly imperial and at the same time comprehensible.

The chapters on the Mutiny Act for America and the taxation issue tend to emphasize the divergent concepts of whiggism and the Glorious Revolution held by the British and the Americans. English whiggism had degenerated into the doctrine of parliamentary supremacy, while American whiggism continued to endorse the orthodox view that certain fundamental rights were inalienable rights of all Englishmen. Chief among these rights was

the exemption from taxation but by one's own consent or the consent of one's representatives. Chatham, almost singly among British leaders, endorsed the limitations which the Americans conceived were applicable to parliamentary authority. The confusions spread by Rockingham's repeal of the Stamp Act accompanied by the mistaken notion that the colonies drew a distinction between internal and external taxation tended to polarize the differences. Chatham's untimely and prolonged illness removed the possibility of rectification. Even if Chatham had retained his health, it is highly problematical whether he could have solved the imperial problem in face of the intransigent belief in parliamentary supremacy expressed by most Britons, including the chauvinistic monarch and the equally firm, though contrary, convictions held by the Americans.

The chapter on the West concerns the British executive more than the Parliament; yet the narrative does point out the close affinity between the British executive and legislative authorities. Western policy affected the vital interests of the colonies and yet the King and his ministers turned their backs on colonial aspirations westward. Rebuked by King and Commons over constitutional rights and internal growth and development, where else could the colonies turn for justice?

Microfilm \$3.55; Xerox \$12.40. 274 pages.

HISTORY, MEDIEVAL

CONSISTENCY OF THOUGHT IN
THE WORKS OF BERNARD OF CLAIRVAUX:
A STUDY OF MYSTICAL LEADERSHIP
IN THE TWELFTH CENTURY.

(L. C. Card No. Mic 60-2571)

John Robert Sommerfeldt, Ph.D.
University of Michigan, 1960

The aims of this work are to examine the thought of Bernard of Clairvaux in terms of the expression it gives to the values implicit in much of early twelfth century culture and to investigate the meaning of this explication for the consistency and order of that society in which he assumed such an important leadership role. An attempt is made to discover whether this leadership was the expression of consistent ideals and whether the rationale of

that leadership as expressed in Bernard's works succeeded in making any possible consistency apparent or in resolving any possible inconsistency.

In this endeavor to gain an insight into the Weltanschauung of the twelfth century as mirrored in the thought of one of its most influential leaders, an attempt is made to get to the center of the value complex by an analysis of epistemological theories implicit in Bernard's writings. In order to complete this picture it is seen that an examination of his sociological, educational, legal, and papal leadership theories is necessary.

Bernard has often been described as an obscurantist due to his violent condemnation of Abelard; however, his opposition was based not on an antagonism to Abelard's application of dialectics to theology, but rather on a misunderstanding of the schoolman's position on the efficacy of reason and, primarily, on the theological errors which Abelard propounded. Bernard's view of the legitimacy of reason is shown by his patronage of young scholars and his friendship with masters of learning, and by his adroit use of dialectics in his many theological treatises. However, Bernard considered that mysticism had a great epistemological value and his concept of the education which prepared the monk for contemplation allowed no place for advanced intellectual training; thus it would seem that his thought contained contradictory elements.

However, Bernard's sociological theories distinguished three states of life: that of the monk, the secular cleric, and the lay person. These three states of life had as their proper means of obtaining the truth the contemplative, intellectual, and experiential or common sense ways to knowledge. Bernard's educational theory stemmed from a value hierarchy associated with his epistemological, sociological, and educational classifications based on their relative efficacy in attaining union with God. Thus the contemplative life was superior to the active life as the active life was superior to the lay life. The problem of the relationship of the official leadership of the papacy to the charismatic leadership of Bernard the monk was resolved by him by recognizing that the power of God could be obtained both from succession to office or directly from Him.

Bernard's extraordinary influence on the society of his time can perhaps be best explained by the fact that he not only was a member of that element of society which best expressed the ascetic-Christian value orientation of so great a part of that society, but he also presented to his contemporaries a rationale for the existence of all other significant elements of that society. This man was at once a most powerful spokesman of his age and a most powerful influence on his age.

Microfilm \$4.25; Xerox \$14.85. 330 pages.

HISTORY, MODERN

RICHARD OLNEY, CORPORATION LAWYER AND ATTORNEY GENERAL OF THE UNITED STATES, 1835-1895.

(L. C. Card No. Mic 60-2527)

Gerald Gordon Eggert, Ph.D.
University of Michigan, 1960

This study attempts to reconstruct Richard Olney's career as a railroad and corporation lawyer and as Attorney General of the United States, and to trace the relationships between his long-time private practice and his conduct while head of the Justice Department. Although Olney held high office and was a dominant force in shaping public policies during the second administration of President Grover Cleveland, no adequate biographical study has been made of his career for the period prior to his becoming Secretary of State in June, 1895.

The first four chapters of the study deal with Olney as a corporation and railroad counsel and director. After an examination of his family background, his education at Leicester Academy, Brown University, and Harvard Law School, attention is turned to his rise to prominence at the Boston bar. Olney's successful handling of the reorganization of the near-bankrupt Eastern Railroad of Massachusetts in 1876 earned him a reputation and a place on the board of directors of first the Eastern and later the Boston & Maine and the Burlington railroads. During the 1880's and 1890's Olney was responsible for the legal and legislative work involved in forging the small railroads of northern New England into the Boston & Maine system. Olney also devoted much of his time and effort to thwarting state and federal regulation of railroads. The first portion of the study concludes with an evaluation of Olney as a lawyer and as a person on the eve of his entering public office.

How Olney came to be appointed to the cabinet is related in chapter five, and the remaining seven chapters deal with him as Attorney General. While in office Olney continued in the hire of some of his important clients, including the Burlington Railroad, and was subjected throughout his term to pressures from his business associates. Although Olney's policies with respect to the trust problem, the income tax, the Panic of 1893, the reorganization of the Union Pacific Railroad, the march of the Coxeyite armies, and the Pullman Strike were all significantly influenced by his long experience as a corporation attorney and by his continuing ties to the business world, these forces by no means wholly determined his course of action.

Following the Pullman Strike, which earned him a national reputation and the acclaim of the "better elements," Olney broke a number of his ties to the railroad community and adopted a friendlier attitude toward labor. He called for recognition of the right of workers to organize and to strike, and he drafted legislation which provided for the arbitration of railway labor disputes. Upon the death of Secretary of State Gresham in May, 1895, Olney was appointed to head the State Department. A new and broader field of operation opened to him as he for the first time in his adult life turned his attention away from the practice of law.

Four main conclusions are reached in this study.

(1) Prior to entering public life Olney played a major role in creating the Boston & Maine railway system and was recognized as one of New England's leading corporation lawyers. (2) Shortly after becoming Attorney General he emerged as the most influential member of Cleveland's second cabinet. (3) His policies as Attorney General were strongly influenced by his past and continuing ties to the business and railroad communities. (4) Olney revealed a capacity for growth following the Pullman Strike by becoming increasingly independent of the railroads and by approaching the labor problem less as a corporation lawyer and more as a statesman.

Microfilm \$6.35; Xerox \$22.50. 498 pages.

GERMAN-PERSIAN DIPLOMATIC RELATIONS, 1873 - 1912.

Bradford G. Martin, Ph.D.
Princeton University, 1958

[Please Note: To obtain copies of this thesis,
please write directly to Mouton and Co.,
'S-Gravenhage, Netherlands.]

Based on Russian and Persian sources, as well as unpublished German diplomatic documents, this study of German-Persian diplomatic relations covers the period from the start of official contacts in 1873 to the conclusion of the Russo-German Convention of 1911. It consists of an introduction (9 pages), four chapters (270 pages) and a bibliography (9 pages).

The first chapter ("The Bismarck Period," pp. 1-56) treats German-Persian relations from 1873 to 1890, which may be characterized as a series of challenges to Persia from Great Britain and Russia, which Nasir ad-Din Shah countered by trying to involve the Imperial German Government in Persian affairs. Of interest are the Shah's neutrality proposal of 1880, by which Germany and Austria-Hungary were to guarantee Persia's frontiers against Russian encroachments, and his later requests (1885) for technicians, military instructors, and administrators. Bismarck, however, felt that German interference in Persian affairs--by diplomatic means, constructing roads or railways or renovating the Persian governmental machinery--would merely disturb Russo-German relations and yield to tangible advantages. While Nasir ad-Din Shah's ingenious plans to get German aid and protection failed, they point up a curious paradox: Nasir ad-Din Shah was more than willing to encourage a potentially dangerous imperialism within the borders of Iran to hold back the Russians and British. This theme occurs

constantly throughout this 39-year period, and applies not only to the thinking of Nasir ad-Din Shah but to his successors.

As early as the late 1870's German armaments firms, such as Krupp of Essen, began to take an interest in the Persian market. This was even more true of the period covered in Chapter II ("Towards Imperialism, 1890-1905," pp. 57-118) when a change of tone in articles appearing in the German press on the subject of Persia foreshadowed a growth of imperialistic interest and the abandonment of Bismarck's cautious policy. By 1898 plans had been drawn up for a railway from Khaniqain to Tehran, which was to join the main line of the Baghdadbahn near Sa'diyya in Iraq. At the same time the Persian Government expressed its desire for a German loan. This proposal was undoubtedly made to give Germany a stake in the continued independence of Persia. By 1900 it is clear that certain German financial groups and diplomats were interested in extending the boundaries of the Middle Eastern economic colony which they were acquiring in the Ottoman Empire into Persia.

German imperialism reached its highest point between 1906 and 1912 (see Chapter III, "Culmination and Collapse of German Imperialism," pp. 119-251). Starting with German diplomatic intervention in a Persian-Turkish border dispute in late 1905, German interest continued with the establishment of a German shipping line to Persian Gulf ports. Such obvious interest caused the Persian Government to offer the Wilhelmstrasse a bank concession, which was accepted on behalf of the Deutsche Orientbank. A lack of financial opportunity and a poor outlook for profits finally caused this bank to abandon the concession, and although the Deutsche Bank was briefly interested in founding a branch in Tehran, it also withdrew in 1910. Even so, both banks were bitterly attacked by British and Russian financial interests, and excoriated by the press of these two countries.

Politically, the period 1906-1912 in Persia was marked by an Anglo-Russian rapprochement, accelerated by German activity. At the same time Russia tried to come to an agreement with Germany. The first phase of this attempt failed; but the second succeeded, when in 1911 the Tsarist Government was able to hoodwink German diplomats into accepting some very temporary advantages in exchange for an indefinite plan to build the Baghdadbahn into Persia and official renunciation by Germany of intensive commercial effort in the Russian sphere of influence in north Persia. At the same time Persian public opinion, which felt that Germany had sacrificed Persia to Russia, veered against Germany. Germany only regained its previous place in Persian public esteem on the outbreak of the first World War when it fought simultaneously against both of Persia's traditional enemies.

HOME ECONOMICS

IN-SERVICE EDUCATIONAL NEEDS OF A SELECTED GROUP OF HOMEMAKERS WHO ENTERED OR RE-ENTERED THE TEACHING OF HOMEMAKING

(L. C. Card No. Mic 60-2498)

Mary Jane Scott, Ed.D.
The University of Tennessee, 1960

Major Professor: Druzilla C. Kent

The purpose of this study was to identify those professional problems which seemed to be unique to a selected group of teachers who had entered or re-entered the teaching of homemaking after a period of five or more years between their pre-service preparation and recent employment. The professional problems, if identified, might provide useful data for persons or groups concerned with in-service educational programs for such teachers.

The study was limited to eight states in the Southern Region--Alabama, Arkansas, Georgia, Mississippi, North Carolina, Oklahoma, Tennessee, and Texas.

Data were collected in the winter of 1959 through questionnaires which were mailed to state supervisors of home economics education, married teachers who had recently entered or re-entered the teaching of homemaking after a nonteaching period, married teachers who had been teaching homemaking continuously for five or more years, and administrators of secondary public schools employing the teachers.

The hypothesis was that the professional problems of teachers who entered or re-entered the teaching of homemaking after a period of five or more years between pre-service preparation and employment or between periods of employment will not differ from the professional problems of teachers who have been teaching homemaking continuously for five or more years. While the findings tended to support the hypothesis, there were differences between the numbers of the two groups of teachers who reported certain problems.

More of the teachers in Group I than of those in Group II reported that they had difficulty in:

1. Directing FHA activities.
 2. Evaluating the effectiveness of their homemaking programs.
 3. Finding time in their home and school schedules for making home visits.
 4. Planning the home experience phase of the program.
- Fewer of the teachers in Group I than of those in Group II

planned the homemaking programs with pupils, parents, and administrators.

The number of teachers in both groups reporting the following problems would seem to be important for those persons responsible for developing in-service educational programs:

1. Planning the adult phase of the program.
2. Inadequate equipment for teaching all phases of homemaking.
3. Working with pupils of different abilities in one class.
4. Inadequate funds for the department.
5. Planning the budget for the department.
6. Inadequate library facilities.
7. Difficulty in the use of self-evaluation by pupils.
8. Difficulty in the use of problem solving.
9. Difficulty in the use of the essay test.

Members of the teachers in Group I requested the following services from state supervisory staffs and college or university faculties: small study groups, a sectional meeting at the state conference for homemaking teachers devoted to their needs, initial visit from the supervisor early in the year, extension classes, and summer classes of two or three weeks.

The findings pointed to a need for further study in the following areas:

1. The management problems of married women who are maintaining homes and teaching homemaking.
2. Methods by which married women who teach homemaking and have young children are providing for the care of the children.
3. The possibility of using two part-time homemaking teachers instead of one full-time teacher when the teachers have responsibilities for a home and family.
4. An examination of services rendered by homemaking teachers to the schools and communities to determine those which might be less essential.
5. The use of well-qualified, experienced teachers as leaders of small study groups comprised of teachers in neighboring centers as one method of supplementing the services of state supervisory staffs.
6. Re-evaluation by teacher education institutions of offerings and techniques of counseling for teachers in service.
7. Experimentation by teacher education institutions with short courses of two or three weeks, extension classes, Saturday Classes, and consultant service for homemaking teachers in service.

Microfilm \$2.95; Xerox \$10.35. 228 pages.

LANGUAGE AND LITERATURE

LANGUAGE AND LITERATURE, GENERAL

THE CHILD CHARACTER IN HAWTHORNE AND JAMES

(L. C. Card No. Mic 60-2611)

Frederic Joseph Masback, Ph.D.
Syracuse University, 1960

Hawthorne and James both saw the child character as an innocent exposed to an evil world, and they used this confrontation as a device for examining and evaluating varying and often opposed values, conduct, and perceptions. They not only recognized that the growth of moral consciousness in every human being could be symbolized through the child's experience, but they saw particular similarities between the situation of the artist and that of the child.

Despite these similarities, they treated the theme in very different ways. Most of Hawthorne's child characters are endowed with a large measure of intuitive knowledge about what is good, true, and beautiful, while James' child characters usually have to develop such knowledge through experience. Hawthorne's children usually profit from their experience with the world. To their intuitive knowledge is added worldly knowledge, and the two combine to produce a sympathetic, fully-developed human being. James' children, on the other hand, either cannot or will not adjust to the demands of the world; their innocence is never transformed into virtue, since they usually die when they are first exposed to a serious moral problem.

The only notable exceptions to these generalizations are Ilbrahim in Hawthorne's "The Gentle Boy" and Maisie in James' *What Maisie Knew*. Ilbrahim, an early Hawthorne creation, is quite similar to such Jamesian child characters as Morgan Moreen and Dolcino Ambient, while Maisie, appearing in a late James novel, has closer affinities to Hawthorne's Pearl than to other Jamesian children. Thus, while Hawthorne came to an optimistic treatment of the child's situation rather early in his career, James seems to have avoided it until relatively late in his career.

Not only is Hawthorne generally more optimistic than James about what happens to the child as a result of his contact with the world, but he is also more hopeful than James concerning the beneficial effects which adults derive from their associations with children. Hawthorne's children usually emerge as successful human beings, but some of their triumph is qualified by the fact that their experience of evil is not as shattering nor as decisive as that of James' child characters. James' children are usually placed in a much more difficult position in which their survival can only be assured by a sacrifice of their freedom and integrity. Thus their deaths become their finest achievement in the realm of moral choice.

Both authors see the child's values and vision as superior to those of the adults with whom they are associated. Hawthorne, however, portrays a world in which the child's values triumph by prevailing, while James

creates a world in which renunciation of worldly values is the only triumph.

Microfilm \$3.85; Xerox \$13.50. 299 pages.

THE DESCRIPTION OF STYLE: DR. JOHNSON AND HIS CRITICS.

(L. C. Card No. Mic 60-2562)

Leo Rockas, Ph.D.
University of Michigan, 1960

This study aims to discover whether a descriptive stylistics must always partake of intuition, impression, and value, or whether it may ever be conducted on objective grounds. As a means of limitation, it chooses the commentators on Johnson's style, one large body of stylistic critics with a common object of description, and examines their principles, their procedures, and their results.

The first chapter reviews the various definitions that have been proposed of style, and chooses as the most convenient handle for description this one: any composite of traits distinguishing one class of works agreed to be literary from another. Next come the two problems: 1.) which works or which passages should be chosen as the one style to be studied; and 2.) which other works or passages should be chosen as a contrast to this style. Both problems are resolved only by a circularity: the results will show which area of works share sufficient qualities to have been considered one style in the first place; and the contrast will also be better shown at the end, than the beginning, of research: it will be the one other style closest to the first, but still distinct from it. Next comes the problem of which traits are legitimate and appropriate to be taken up in distinguishing one style from another, and it is decided that any trait, from the most broadly substantive, to the most intimately rhetorical, is fair ground.

The second chapter takes up the methods and techniques that have been or may be utilized in stylistics. Techniques are defined as any miscellaneous devices which assist in pursuing the methods. And the methods are here understood according to the medieval trivium--logic, grammar and rhetoric--freshly defined. Logic is taken to be a systematization of the broad area of substance itself. Grammar is taken to be the whole area of linguistics. Rhetoric is taken to be the ancient and medieval art of decoration, actually a miscellaneous grouping of "figures" which logicians and grammarians disregard. The major technique in pursuing these methods is statistical, since traits are widely shared among authors, and only frequency of usage is distinctive.

The final chapter considers and tests the results of stylistics, first the purely descriptive results and the means of arriving at them. The effort to duplicate

statistics here is successful enough to offer some hope that even closer correspondence between two critics is possible. Interpretations of results are next taken up, extending to evaluations of the style under examination, and to prescriptions concerning the reader's own style. It is suggested that such interpretations be kept apart from description.

The conclusions of the study are both particular and general. The critics of Johnson's style have succeeded in their aim of describing his style so as to differentiate it from a hypothetical norm or eighteenth- and nineteenth-century style, but they have not differentiated it from a style more closely similar to Johnson's, for example Gibbon's. In general, despite the failure of perfect correspondence among critics, a descriptive stylistics appears to be scientifically possible.

Microfilm \$2.50; Xerox \$7.40. 156 pages.

LANGUAGE AND LITERATURE, LINGUISTICS

PIKE'S TAGMEMIC MODEL APPLIED TO TOTONTEPEC MIXE PHONOLOGY

(L. C. Card No. Mic 60-2521)

John Chapman Crawford, Ph.D.
University of Michigan, 1960

The purpose of this study is to apply the model of language description presented in Kenneth L. Pike's Language in Relation to a Unified Theory of the Structure of Human Behavior, Parts I and II (Glendale, California, 1955-56) to the description of the phonological structure of a particular language, Totontepec Mixe. This purpose may be subdivided into three major parts. One is the presentation of language data not previously described. A second is that of attempting to clarify the meaning of the model proposed by showing its applicability in the relatively simple area of phonological structure. A third purpose is that of providing a test for the model, since this is the first comprehensive test of Pike's system to the area of phonology. As a result of the study, certain changes are recommended to the basic outline of language description presented by Pike. These do not constitute, in the writer's opinion, any change in the most basic premises of Pike's Language.

The introduction to this study is devoted to pointing out the main characteristics of the description to follow and to a summary of Pike's model as it applies in the area of phonology. The next five sections describe units of phonological structure, from phoneme length to phrase length units and present an illustrative text. A final section is devoted to a discussion of the major points of difference between this description and Pike's model as found in his Language.

The greatest impact of Pike's model to date in the area of grammatical studies has come from his interpretation of units of grammatical structure, which he labels Tagmemes. (This term was used earlier by Leonard Bloomfield, but with a somewhat different meaning.) In this

system Pike distinguishes between lexical units, which are morphemes or morpheme sequences, and tagmemic or grammatical units. A tagmemic unit (as for instance a "Subject" of a clause), consists of a correlation involving a distribution class of lexical units and the function shared by the members of such a class.

In making an explicit distinction between units of phonemic structure and units of phonotagmemic structure, paralleling the distinction between units of lexical structure and units of tagmemic (grammatical) structure made by Pike, this presentation differs from the framework of description set up by Pike. Pike describes language in terms of three hierarchical structures--phonology, lexicon, grammar. This study suggests the alternative of viewing this as a doubly-bipartite structure, composed of lexical units (morphemes, words, etc.) and units of grammar (tagmemic units) on one hand, and phonemic units (phonemes, syllables, etc.) and units of phonotagmemic structure on the other.

Microfilm \$3.15; Xerox \$11.05. 243 pages.

A COLORADO WORD GEOGRAPHY

(L. C. Card No. Mic 60-2535)

Clyde Thomas Hankey, Ph.D.
University of Michigan, 1960

This study is an over-all description of the linguistic geography of Colorado. The source of data is the field records collected for the Linguistic Atlas of Colorado. Attention here is focused chiefly upon the distribution of vocabulary and grammatical features that are important either because they are limited in their spread throughout the state or because they have appeared significant to American dialects in the East and Midwest. The procedure has been the selection and analysis of these meaningful parts of the total data.

The study is related in aims and methods to previous studies of American English dialects. A discussion of these studies, the Colorado Atlas project, and the communities and informants provides a background to subsequent analysis. Examination of the relative strength and spread of Eastern dialect words in Colorado shows only a limited spread of Southern terms and a widespread Northern-Midland mixture. Both age differences and peculiarities of distribution suggest that this mixture is partly the result of Northern terms spreading over an early and continuing Midland base. Further features significant here are: (1) limited distributions of typically Midwestern terms in Colorado, (2) a variety of semantic developments----differentiation, confusion, and polysemy----that appear in Atlas data for the state, and (3) a surprising vitality in Colorado of some Eastern and Midwestern relics.

Having examined these external relationships, the study proceeds to a description of the internal makeup of Colorado's language. The bundling of isoglosses reflects three distinct, but relatively minor, dialect areas--the eastern plains, southern Colorado, and southwestern Colorado. Further analysis of Colorado language patterns uses "participation maps"; each of these maps indicates the degree to which different communities share a group of terms that resemble each other in geographical spread--

but not closely enough to allow a clear presentation by means of isoglosses. The result of this analysis is the presentation of ten participation areas, four of which are prominent enough to account for much of the state's linguistic variety. These major areas are: (1) a central area which includes Denver and indicates the most likely focal area among Colorado dialects; (2) a northwestern area composed of the more recently settled communities, and most likely to resemble southern Wyoming in usage; (3) an area sweeping across the mountains from the northeastern to the western parts of the state; and (4) an area linking the Arkansas valley with western Colorado. The overlapping of the last two areas in western Colorado provides a graphic explanation of the especially thorough dialect mixture in western Colorado.

Surveying the evident or probable social differences in Colorado usage discloses terms which are proportionally more frequent among older folk speakers, as well as among older or younger or folk or cultured speakers. In contrast to younger and/or cultured speakers, older and/or folk speakers use many terms that are restricted to those social groups. A few Spanish loanwords are important to Colorado's dialects because they are limited to southern or southern and eastern Colorado.

Two general conclusions may be drawn from this examination of Colorado's linguistic geography. (1) The characteristic dialect mixture is that of the transition area. This mixture, more noticeable and intimate as one moves from east to west, reflects the facts of the state's settlement and later history. (2) The mixture is not, however, completely erratic. While Colorado's language patterns rarely show definite dialect boundaries, there is in Colorado a kind of linguistic ferment which might give rise to dialect development peculiar to this state and parts of the Rocky Mountain region.

Microfilm \$2.50; Xerox \$7.20. 154 pages.

PHONEMIC AND SUB-PHONEMIC REPLACEMENT OF ENGLISH SOUNDS BY SPEAKERS OF JAPANESE

(L. C. Card No. Mic 60-2545)

Sutesaburo Kohmoto, Ed.D.
University of Michigan, 1960

The purpose of this study, as given in Chapter 1, is to find replacement of English consonants and vowels commonly made by native speakers of Japanese in learning English pronunciation. By replacement in the study is meant the Japanese pronunciation of English sounds such that the deviation either results in phonemic distortions or causes peculiarities, or sub-phonemic distortions, in pronunciation compared with the speech of native speakers of American English. A further purpose is to determine the relative degree of difficulty that each pronunciation problem presents to the Japanese learner. This study limits the problem to the pronunciation of sound segments on a conscious production level.

In Chapter 2 of the study, a description of colloquial American English segmental phonemes and their allophones, and of consonant clusters is presented. In Chapter 3, a description of colloquial Standard Japanese segmental

phonemes, and their allophones and of consonant clusters is presented. These descriptions are based on work previously done by several prominent scholars of each language. In Chapter 4, the two sound systems are summarized in parallel columns in order to point up the similarities and dissimilarities between the two systems.

In Chapter 5, the Japanese replacement of English sounds is presented, partly being based on the author's teaching experience and partly by comparing the two systems theoretically. This presentation is organized according to types of replacement. Here also, the degrees of difficulty are predicted, according, on one hand, to the degrees of dissimilarity of English sounds in comparison with their Japanese counterparts, if any, and, on the other, to the author's findings from his own teaching experience.

In Chapter 6, the author tries to verify his predictions of replacement and degrees of difficulty. The procedure here was to have five Japanese speakers, all studying at colleges in the U. S., read and record on tape English sentences containing various types of trouble spots. Then, native speakers of American English and the author checked the recorded pronunciation to discover whether the predicted replacements were actually made or not.

The results indicate, on the whole, that, as predicted, the greater the similarity between sounds of the two systems, the lower the frequency of replacement. It is concluded: (1) that the points of replacement of English sounds by the Japanese speakers correspond to the points of difference between the two sound systems, and (2) that some sequences of English sounds turn out counter to this principle, and, also that, contrary to the predictions, the English consonants that have no counterparts in Japanese, with the exception of "r," are not frequently replaced by advanced students speaking on a conscious level; and (3) that the English vowels of greatest dissimilarity to the Japanese are most frequently replaced, as predicted.

The important parts of this study are: (1) the author's efforts to collate previous studies of the Japanese sound system and organize the facts in a succinct form in order to meet a practical and pedagogical need, (2) the comprehensive treatment of both phonemic and allophonic replacement of English sounds made by the Japanese, (3) the prediction of the degrees of difficulty in overcoming various English pronunciation problems, and (4) the testing of these predictions by the use of native informants.

The practical value of this study for pedagogical application lies in the fact that the results attained will provide the basis for the selection and arrangement of a number of selected items of English pronunciation for Japanese learners in a properly related sequence with special emphasis upon the chief trouble spots.

Microfilm \$2.50; Xerox \$8.60. 186 pages.

PHONEMIC THEORY A (WITH APPLICATION TO MIDWESTERN ENGLISH)

(L. C. Card No. Mic 60-2583)

William Shao-Yung Wang, Ph.D.
University of Michigan, 1960

The purpose of this study is to develop a phonemic theory which is oriented to the field of automatic speech

recognition. A phonemic theory is regarded as a device in terms of which various methods of symbolizing the sentences of a particular language may be objectively evaluated. The Phonemic Theory A presented in the first part of this study is characterized primarily by the properties that 1) it is formulated within an acoustic-phonetic framework, 2) it prefers methods of symbolization which provide a good sound-to-symbol correspondence, and 3) it makes little explicit use of morphological information.

The sound wave of any sentence may be specified for linguistic purposes in terms of the time functions of its spectrum, of its fundamental frequency, and of its over-all intensity. Phonemic Theory A is not equipped to evaluate methods of symbolizing the latter two time functions. Since physical differences in these two time functions are linguistically significant for many languages, Phonemic Theory A must be considered to be incomplete in this respect.

Phonemic Theory A is stated by means of the axiomatic method. The undefined terms in the theory are "sentence" and "repetition". It is felt that these terms may be profitably used despite the lack of psycho-linguistic techniques in terms of which they may be given operational meaning. Some elementary logical results have been utilized in the development of Phonemic Theory A; for example, the partition theorem of equivalence relations.

The second part of the study is concerned with an application of Phonemic Theory A to a sample of speech. The sample contains the recorded speech of three persons who are natives of southeastern Michigan and northwestern Ohio. The sample is analyzed instrumentally by the 48-channel sound spectrograph and the mingograph.

Various methods of symbolizing the acoustical patterns, as shown on the 48-channel spectrograms, are evaluated in terms of Phonemic Theory A. For example, in terms of Phonemic Theory A it is considered preferable to symbolize [tʃ] and [dʒ] with two symbols because they each contain two minimal portions. A specific alphabet is proposed for symbolizing the sample which has been collected. This alphabet is presented as one which best satisfies the conditions of Phonemic Theory A. The transcription of the entire sample, in terms of this alphabet, which contains some 20,000 phonemes, and some illustrative spectrograms are included as appendices.

The study concludes with a brief discussion on the applicability of Phonemic Theory A to several phonemic problems which are not related to English. It is emphasized that although Phonemic Theory A is appropriate for such purposes as automatic speech recognition, it does not yield optimal methods of symbolization for describing over-all grammars. For the latter purpose, the theory would have to be expanded and additional assumptions would need to be made.

Microfilm \$2.50; Xerox \$7.40. 158 pages.

A STUDY OF THE PRACTICAL APPLICATION OF STRUCTURAL LINGUISTICS TO THE TEACHING OF ENGLISH IN LEBANESE ELEMENTARY SCHOOLS

(L. C. Card No. Mic 60-2591)

Richard Clements Yorkey, Ed.D.
University of Michigan, 1960

The purpose of this study is to investigate the ways in which the pedagogical procedures derived from the premises of structural linguistics can be applied to teaching English in Lebanese elementary schools.

Chapter II surveys the educational system of Lebanon. This includes a detailed description of the English program and an analysis of the government-prescribed syllabus, textbooks, and primary certificate examination. This chapter presents the framework into which linguistic procedures must fit if they are to have any practical meaning for Lebanese teachers of English.

Chapter III introduces some general premises of linguistics concerning the nature and function of language, including descriptive techniques for the structural analysis of language and the methodology of making a contrastive analysis of two linguistic systems. Chapter IV describes the pedagogical procedures that can be derived from these premises, exemplified by materials of the English Language Institute and the ACLS series. Two main areas are surveyed: teaching materials and teaching methods, with a detailed study of techniques for teaching the skills of listening, speaking (under which are included pronunciation, vocabulary, and grammar), reading, and writing.

Chapter V studies the practicability of applying these techniques to the specific problems and requirements of teaching English in Lebanese elementary schools. The investigation parallels the preceding chapter, with the main emphasis on teaching materials and methods. Four main problems are identified.

1) Government officials, school administrators, teachers, and parents are likely to be suspicious of or indifferent to a methodology which is based on speech rather than reading and writing in the early stages, and which stresses the development of habitual skills rather than intellectual discipline and conceptual learning. A realistic understanding of the nature and function of language is therefore necessary before they can be convinced of the value of aural-oral procedures for language teaching.

2) The teaching load is high and salaries are low; only about 10% of the teachers have had training in education, and even less in English teaching; and the teachers' command of English in most cases is limited and few have anything near native-fluency. A teacher training program must be instituted before aural-oral methods for teaching English can be applied. Unless teachers understand the underlying linguistic premises of the teaching procedures, unless they feel these procedures are practical and relevant to their problems, and unless they actually see demonstrated the improved results of these procedures, they will be reluctant to exert the necessary time and effort to make adjustments in their current teaching methods.

3) Lebanese teachers regard the textbook as a "master-teacher" which determines the content, sequence, presentation, and exercises for their English teaching. There is an urgent need for structurally-oriented materials written specifically for Arabic-speaking students. These must

include sufficient drill materials to make up for the teachers' lack, explanations must be simple and clear with many examples, and if transcription is used, it must not be unduly cluttered. Content should be drawn from the experience and interests of specific Lebanese age groups. Vocabulary should be limited, with selection based on the same frequency-counts as the supplementary readers.

4) Aural-oral teaching methods must be adapted for overcrowded classrooms. Teachers must be trained in techniques of presenting the model, providing practice and correction, and varying the drills.

Areas that require further research are (1) effective methods for teaching reading and writing, (2) structuring the cultural content of teaching materials, (3) determining the pedagogical values of using or not using transcription, (4) differences of methodology for adult as opposed to elementary school students, and (5) the possibility of making an inventory of English grammatical structures on the basis of frequency of occurrence, naturalness, regularity of form, function load, and with reference to Lebanese Arabic, the degree of learning difficulty.

Microfilm \$4.45; Xerox \$15.75. 346 pages.

LANGUAGE AND LITERATURE, MODERN

A STUDY OF LITERARY CRITICISM BY SOME NEGRO WRITERS, 1900-1955.

(L. C. Card No. Mic 60-2508)

Ila Jacuith Blue, Ed.D.
University of Michigan, 1960

It is the purpose of this study to examine some writings in the area of literary criticism by Negro writers during the period 1900-1955. The study has two aims. The first one is to single out the central problems of literary theory with which these authors are concerned and to find out what judgments they have expressed concerning them. Only those problems of literary criticism upon which enough opinion has been given for a pertinent discussion will be examined. The second aim is to give some judgment on the material analyzed.

The authors whose works are examined in this thesis represent an arbitrary choice. There were, nevertheless, certain requirements imposed upon the selection. First of all, the choice was restricted to writers who had won some recognition as creative artists in the field of literature. Secondly, the study included those authors whose writings on literary criticism have spanned a large number of years and have covered a variety of problems in creative literature.

A chief source of these critical loci was the general and professional magazines published by Negroes. Another source was the newspapers which carried book reviews and essays by Negroes. These critical data are grouped under four main headings: the nature and function of literature, of criticism, of poetry, and of fiction. The treatment of each problem is divided into two parts. The first part contains quotations from selections by the various authors who deal with the problem under discus-

sion. The second part is that of analysis, with a view toward correlating the opinions given by the Negro critic against the contemporary background of American criticism.

The two most popular areas for these critics are the nature and function of literature and of fiction, each of which is discussed by fifteen critics. Eleven authors comment upon the problems of poetry; nine deal with the function of criticism.

These Negro critics believe that literature by Negroes follows no peculiar pattern of its own. Although at times it may show differences of emphasis, literature by the Negro keeps in step with the general aesthetic trends of general American literature. Whatever "school" of art is in vogue in contemporary American literature, the Negro author will reflect it. Whether one writes art for art's sake or literature for propaganda, the important thing is fidelity in treatment of subject matter and universality in outlook. No matter what the aim of the artist is, he must never distort the material of his art to conform to his personal prejudices.

With the exception of Braithwaite and Brawley, these critics agree with Menchen's statement that the critic should be a "catalyzer." It is the business of the critic to bring about understanding and appreciation between the reader and the literature so that an intelligent enjoyment will be effected.

Generally in the early half of the century the emphasis was on subject matter. During the past two decades the emphasis has shifted from subject matter to style. Midway between these two groups are the critics who think of style and substance as one, both integrated or blended to accomplish successfully the function of interpreting life and attitudes.

The Negro critics have clarified the various theories subscribed to by the Negro authors who are both writers and critics and those who are critics only. In addition to these general contributions, the Negro critics have made a special contribution of increasing the understanding of irony in modern fiction, especially in the sociological novels. Microfilm \$3.25; Xerox \$11.50. 251 pages.

PASTORELAS AND SERRANILLAS, 1130-1550: A GENRE STUDY.

(L. C. Card No. Mic 60-2523)

John David Danielson, Ph.D.
University of Michigan, 1960

This work is a specifically literary study of the Old Occitan *pastorelas* of the twelfth and thirteenth centuries and the Castilian *serranillas* of the fourteenth, fifteenth and early sixteenth centuries—with emphasis on the latter. It makes no claims of a philological sort, and is only marginally concerned with historical questions. The interest of the investigation stems from the following: (a) the genre contains a number of poems of high quality; (b) while the *pastorelas* and *serranillas* are obviously of the same general type, they display—from group to group and within each group—marked differences in texture and structure; and (c) the study of genre, and of this particular genre, present problems of importance to the discipline of literary criticism.

The first third of the work is composed of an introductory chapter and four chapters on the *pastorelas*, the remaining two-thirds of four chapters on the *serranillas* and a conclusion. In Chapters II-IV the *pastorelas* are approached collectively, first in terms of their major and minor plot-lines, then with respect to the doctrine of Courtly Love. Chapter V discusses a single text, the anonymous *porquiera* from the *Leys d'Amors*. The *serranillas* are divided into four subgroups, discussed separately in Chapters VI-IX. Chapter VI is devoted to Juan Ruiz, Chapter VII to *poetas cultos*, including the Marqués de Santillana, and Chapters VIII and IX to anonymous works.

The method is *descriptive* (seldom evaluative) and wherever possible *collective*—that is, particularly responsive to the idea of *genre*. Where poems are discussed individually, or in small groups, it is done not in isolation, but in terms of what has gone before. Thus the perspective is basically reflective rather than anticipatory, and it is therefore primarily the chapters on the *serranillas* which are *comparative*, approaching the characteristics of the Castilian poems in the light of those of the *pastorelas*. Throughout the work, a distinctive feature of the author's style is the use of copious quotation in support of his assertions.

While the results do not often contradict what other scholars have said about the general outlines of the genre, there is disagreement on a number of smaller points, much that is analyzed in detail for the first time, and some illumination due to the particular orientation of the study. In addition, the investigation could not proceed without the preparation of a list of *serranillas*, fifty-six in number, which appears in an appendix.

Three general conclusions are inherent in the work: (a) what is presumably—or possibly—true about origins, about the "latent state" of medieval poetry, must be clearly distinguished from the actual characteristics of extant texts; (b) detailed study of these characteristics, which reveals the style of the *pastorelas* and *serranillas*, is the most satisfactory means of approaching a description of the genre to which they belong—and as much might be said of other genres; (c) genre study, though instructive in many ways that other approaches are not, has a number of limitations: the need for thoroughness seems to require that it be restricted to certain aspects of the genre in question, it tends to ignore the structural unity of individual works of art, and it rules out esthetic evaluation—to which it may be regarded as a desirable prerequisite.

Microfilm \$2.95; Xerox \$10.35. 226 pages.

ANTIKLERIKALE LITERATUR IM RAHMEN
DES OESTERREICHISCHEN KULTURKAMPFS,
1780-1920: VOM KATHOLISCHEN STANDPUNKT.
[German Text].

(L. C. Card No. Mic 60-2539)

Peter Horwath, Ph.D.
University of Michigan, 1960

The politico-ecclesiastical and the ideological controversies, which started with the Josephinic church reforms and the diffusion of the ideas of the Enlightenment, were

accompanied and supported by a tendentious literature largely aimed at influencing the masses. This literature attacked Catholicism as a religion, as an institution, and as a social and political power. The attacks came from many different quarters and varied greatly in intensity. In the present study the attempt has been made (1) to identify those authors who engaged in anticlerical polemics, and (2) to expose the dominant tendencies underlying their works.

Chapter I provides an outline of the contemporary historical background. Particular attention is paid to the changing relationship between Church and State. Chapter II is concerned (1) with the anticlerical works that accompanied the Josephinic church reforms, 1780-1790, (2) with the political literature of the "Vormärz," 1830-1848, and (3) with the anticlerical literature in the Tyrol, 1838-1861. Chapter III deals with the works of authors who combine anticlericalism with liberal or national tendencies in their writings, 1860-1920. Contemporary political and ideological works which have an anticlerical slant are more extensively considered than purely anti-monastic or anti-Jesuitic novels and dramas.

From a purely literary point of view the Austrian anticlerical literature as a rule has little to offer, but this does not gainsay the fact that it is extremely significant as an expression of the controversial ideas that had great play between the years 1780-1920. The large number of authors engaged during this period in anticlerical polemics is noteworthy: some 150 were located for this study. Caricature, satire, calumny and half-truths are characteristic features of this literature.

During the reign of Joseph II the advocates of a National Church joined forces with the anti-religious elements especially in their attacks on Papalism, Monasticism, and Celibacy. These tendencies were taken over by the political writers of the "Vormärz," who attacked the regime of Metternich. A markedly anticlerical literature developed at that time in the Tyrol as a result of two unrelated events: (1) the return of the Jesuits, and (2) the expulsion of the Protestants of the Zillertal. After 1860 a tendentious literature arose that frequently coupled an agitation for the liberalization of the state with anticlerical and anti-religious polemics. A special literary product of that time were the *Antijesuitica*. In the wake of the "Los-von-Rom" movement and the violent conflicts between the nationalities of the Monarchy after 1890, the anticlerical motives of the preceding period underwent a transformation toward the nationalistic: the power-mad Roman Obscurantism was replaced by a Church that was labeled the archenemy of German humanity; the progressive liberal humanitarian took on the appearance of the Nordic Lord and Master; and the anti-religious attitude of the doctrinaire Liberalism and the idea of a National Church gave way to the demands for a separation of the Nordic-Germanic soul from Christianity, and for the establishment of a new religion on a racial basis.

In conclusion, this literature, viewed summarily, has indefatigably repeated the allegations that Rome is the hereditary arch-foe of mankind, and especially of the German people, that its representatives belong to the scum of humanity, and that the Catholic doctrine is inhuman and dangerous to the state, to morality and to the race. Without the religious disillusionment produced among the masses, a pessimistic nihilism, a revolutionary atheism, and an exclusive racialism would not have taken on such immense

proportions. If, however, political Catholicism during the 19th century had not identified itself so extensively with a conservative and reactionary political and social order, much of that which is most vitriolic in the anticlerical literature of Austria never would have been written.

Microfilm \$2.80; Xerox \$9.70. 215 pages.

WILLIAM FAULKNER: AN INTERPRETATION.

[Please Note: To obtain copies of this thesis, Library of Congress No. 57-7383, please write directly to Stanford University Press, Stanford, California.]

Irving Mesmin Malin, Ph.D.
Stanford University, 1958

In his review of *The Portable Faulkner* Robert Penn Warren suggests that we should study isolated incidents to discover the importance of compulsion and will in the work of Faulkner. But I believe that the themes of rigidity (compulsion) as a personal and social evil and the need to rebel against rigidity in order to gain freedom (will) are so important to Faulkner that he chooses to concretize them in myth. The "images" Warren mentions are, in a real sense, the underlying principles of structure in the major novels.

Faulkner calls the pattern which orders personal existence in basically rigid ways, the compulsive plan, the "design." In his novels the major characters adopt the pattern either in an intellectually conceived or in a sub-consciously desired way. Faulkner's concern with the "design" is important because he can also relate the pattern of compulsion to his own Southern environment. His novels suggest that the organization of the social and religious systems of the South does not allow individual Southerners to realize their own potentialities for human completion.

Faulkner believes that he can concretize his theme of the rigidity of personal compulsion and social organization through the use of the father image. He believes that he can symbolize the rebellion against environmental evils, the quest for new values, through his use of the son.

In his novels Faulkner does not give his full attention to the many-sided problems of women because he is more interested in the conflict between father and son, "design" and quest for identity. He inspects man's world and the women who try to enter it, equating "feminine" women (those he knows least about) with nature.

The study of Faulkner's structural techniques of oppositions substantiates, I believe, my conception of his theme. His oppositions of points of view, of periods of time, his stylistic oppositions suggest the great tensions inherent in our age.

The Old Testament may supply traditional themes to his work, may lend its images to his work - Faulkner is, nevertheless, a modern writer who is trying to do the same thing Joyce does in *Ulysses*. The very nature of Faulkner's parallelism of past and present is associated with his theme of order or - as in his major novels - the wrongness of rigidity as order. In Faulkner's myth there are two behavioral principles continually at battle with each other - flexibility (good) and rigidity (evil). Unlike the Hebrews he believes that rigidity frequently wins.

I demonstrate Faulkner's similarities to Freud in his delineation of ego and super-ego relationships, of psycho-

logical determinism in certain characters. But I try to show that Faulkner is closer to Jung than to Freud because of his concern with the "individuation process," involving meetings with "archetypes," closeness to the animal world and to the four elements, and his symbolic use of rituals.

My conclusion tries to indicate that, like most great writers, Faulkner has seen the essentially mythic qualities of his life in his art.

HEINRICH VON KLEIST'S RECEPTION IN FRANCE. (PARTS ONE-THREE).

(L. C. Card No. Mic 60-2561)

Frank Charles Richardson, Ph.D.
University of Michigan, 1960

The production in France in 1951 of Heinrich von Kleist's *Prinz Friedrich von Homburg*, hailed by French critics as the discovery both of a literary masterpiece and of a dramatic genius heretofore unknown in France, was in reality the culmination of nearly a century of uninterrupted growth of interest on the part of the French toward this enigmatic German writer. Beyond this, French interest in Kleist extends back to Kleist's own era, when attitudes shaped by his disastrous end determined not only the fate of his works in France before 1850, but formed, as well, the framework within which his works were to be viewed until the present day.

Within the unity that the continuous fascination with Kleist's personal fate gives to French critical acceptance of his works, there can be traced three distinct stages or periods, in which French Kleist criticism reveals a somewhat unified outlook. In the first stage, from 1807 to 1869, hampered by the paucity of translations, by the adverse criticism surrounding his suicide, and by the rejection of his work by Mme de Stäel, Kleist's works nevertheless become the subject of critical study and debate, individual works being accepted or rejected largely on the basis of their affinity to French romanticism.

The second stage of Kleist's reception, extending until 1935, though more complicated than the first, shows nevertheless a unity in its essentially rationalistic approach to Kleist and to his works. Following Taine's rejection of Kleist as a romantic, it will be severest toward those works it considers to be romantic and most favorable to those it considers to be realistic. Though reserved at first, as in the 1894 study by Raymond Bonafous, critical acceptance of Kleist in France increases during this period until in the twenties and thirties, in the studies of Charles Andler, I. Rouge, and Roger Ayrault, Kleist finds acceptance in France as one of Germany's greatest literary geniuses. In this period French Kleist criticism evolves from sporadic, often sensationalist articles by enthusiastic Kleist discoverers to original studies thoroughly grounded in research and carried out by noted university scholars.

Within their rationalistic framework, critics of this second stage of Kleist's reception find in Kleist's work proof for the thesis that the opposing forces of mind and heart can be reconciled. Though they do not deny the anguish present in Kleist's works, they see this anguish as possible of resolution.

It is principally in the rejection of this idea of the possibility of reconciliation in life, of the resolution of the schizophrenia at the heart of man and the universe, that critics of the third stage of Kleist's reception, beginning in the late thirties, differ from those of the second. Strongly influenced by Freudian, surrealist, and existentialist thought, critics of the third stage reinterpret Kleist, finding in him and in his work a meaningful representation of the essentially tragic nature of the human condition. Within this latest stage of Kleist's reception, the author's works achieve full acceptance at every level of French intellectual activity and, through their production by Jean Vilar and Roger Planchon, as well as their support by such critics and writers as Gabriel Marcel, T. Maulnier, Julien Gracq, and J. -L. Barault, come to play an important role in post-war attempts to revitalize French theater. In this latter event, and especially in the importance of Kleist's theater to avant-garde dramatists such as Eugène Ionesco and Arthur Adamov, there can be seen the basis for a prediction that the works of Kleist have yet to play their most important role in France.

Microfilm \$3.95; Xerox \$13.95. 306 pages.

DEMOCRATIC VALUES IN MODERN NARRATIVE POEMS

(L. C. Card No. Mic 60-2574)

Edith Opal Stone, Ph.D.
University of Michigan, 1960

It is the purpose of the present study to analyze a number of 20th century narrative poems of book length in terms of their presentation of democratic values. A survey of the field revealed a substantial number of long narrative poems on American subjects, but those emphasizing democratic values are as follows: John G. Neihardt's A Cycle of the West (The Song of Three Friends 1919, The Song of Hugh Glass 1915, The Song of Jed Smith 1941, The Song of the Indian Wars 1925, The Song of the Messiah 1935); Stephen Vincent Benet's John Brown's Body (1928) and Western Star (1943); Theda Kenyon's Scarlet Anne (1939); and Robert Penn Warren's Brother to Dragons (1953).

To analyze the attitudes toward the democratic values, it is first necessary to define the values. Democracy is considered as both a generalized "ideal" democracy and as a form of government. The commonly accepted democratic values--liberty, equality, and fraternity--are defined and limited: liberty as civil or personal, political, and economic; equality as legal, social, and economic; fraternity as a motivating force for the others rather than one of the "inalienable rights." Two values, distinctively American and strongly influenced by the frontier, are added: individualism and optimism.

Neihardt's A Cycle of the West deals with the trans-Missouri frontier from 1830 to 1890. It develops Neihardt's thesis of the "indomitable courage," the freedom and optimism and individualism, of the frontiersmen. The last two Songs also consider the problems of equality and fraternity in the relations of the whites and the Indians. Benet's John Brown's Body considers the problems of liberty and equality in both the North and the South during the Civil War period. Western Star, an account of Jamestown and Plymouth, portrays the issues of economic and

religious liberty on the frontier, and the impetus given individualism, optimism, and equalitarianism by the frontier environment. Theda Kenyon's Scarlet Anne, the life of Anne Hutchinson, is a defense of political, religious, and social freedom. Warren's Brother to Dragons, telling of the murder of a slave by the nephews of Thomas Jefferson, differs sharply from the other poems. It is an attack on democratic idealism rather than a defense of it. Focusing on Jeffersonian idealism, Warren insists that loss of faith in man must result from observing man's evil deeds, and that this in turn must lead to a loss of faith in all idealism.

Two conclusions can be drawn from the study. 1) There is little if any significant relationship between the dates of the poems and the author's attitudes toward the democratic values. 2) Considerable variation in attitudes and emphasis appears in the poems. No author gives equal emphasis to all the values, nor do the authors usually include all of the values in any one poem.

Microfilm \$3.70; Xerox \$13.05. 288 pages.

IDEOLOGICAL ASPECTS OF THE AMERICAN NOVELS OF WORLD WAR II

(L. C. Card No. Mic 60-1723)

Joseph John Waldmeir, Ph.D.
Michigan State University, 1959

This study is an attempt to set forth and examine the pattern of affirmative social criticism discoverable within and among the ideological World War II novels. It is an optimistic and affirmative pattern. It is a pattern painstaking and careful, complete with ferocious contempt for corruption and folly, but, denying the futility of a struggle with man's tendency toward evil, culminating in faith and hope in the dignity and goodness of the individual.

As the first step in the study, I have distinguished between the ideological novels and those whose primary concern is with the objective portrayal of combat action and psychological upheaval resulting from combat, or those whose insincerity or superficiality allows them to be classified as pseudo-ideological. And as the second step, in order better to clarify the ideological position of the war novelists, I have placed them within a historical context, within the tradition of American social criticism as it has developed from the Muckraker 'teens, through the iconoclastic disillusionment of the World War I novels, and the crusading social optimism of the depression years; and I have attempted to delineate points of comparison and contrast along the way.

The main body of the study, from Chapter III through Chapter V, is devoted to the negative and positive aspects of the ideology which informs the war novels. The novelists were violently opposed to fascism, which they found to be a moral rather than a political phenomenon, epitomized in Hitler's Germany and Mussolini's Italy, but certainly not restricted by national boundaries. They attack the German and Italian brands of fascism unrelentingly; but with equal vigor, they attack Americans who, actually or incipiently, are also fascistic. They see and make sound artistic use of the ironic implications in the use of an essentially fascistic institution like the armed services to wage a war against fascism.

But the novelists do not stop at a simple portrayal of

the irony. They search for a positive means to resolve the dilemma from which it stems. They settle upon the individual who, if he is aware of and willing to accept his responsibility for the world as it is and as it may become, embodies the single, reliable resolution. They clearly believe that if the individual will not accept his responsibility and consequently act upon it, there is no hope; but more importantly, they have faith that the individual's experience with war will often convince him to act upon his acceptance. And allied with this faith is hope—a hope which can only be called affirmative, positive, and optimistic.

Chapter VI contains a summary statement of the conclusions arrived at in the dissertation, and suggests briefly that one area of further study may be a comparison of the war novels with other postwar literature, especially with the neo-naturalistic disaffiliated or Beat novels.

The study is concerned only with American novels primarily because the novel seems to have been the principal means of expression for the serious ideological thinkers who wrote about the war, and secondarily, because the American novel seemed the logical choice in the necessary limitation of the discussion to manageable proportions. This hardly to say that poetry, drama, the short story, and reportage contain no ideological material worthy of study and commentary; nor that non-American—especially German and British—war literature should be ignored. Indeed, such work must be undertaken before any absolute statements concerning the ideological interpretation of the war by the creative intellect can be made.

The present study is at least one out of a large and complex procession of steps toward the formulation of such a statement; at best, it will be an important contributing step. Microfilm \$2.60; Xerox \$9.00. 198 pages.

THE RELIGIOUS AND POLITICAL IDEAS OF THOMAS ARNOLD

(L. C. Card No. Mic 60-2587)

Eugene LaCoste Williamson, Jr., Ph.D.
University of Michigan, 1960

Although Thomas Arnold's work in the fields of education, history, and theology has frequently been noticed by historians of nineteenth century thought and by biographers of nineteenth century figures, his religious and political

criticism has not been fully treated. The present study was undertaken in order to supply this lack by providing a detailed treatment of his writings in these fields. It is intended to fill in the outlines of the excellent brief account of Arnold's thought in Basil Willey's *Nineteenth Century Studies* (1949).

The method used is that of analysis and historical evaluation. After a brief introduction and a chapter devoted to the formative influences on Arnold's religious and political views, Arnold's ideas on the Bible, the Church and the State are surveyed (Chapters III, IV, and V). The procedure has been first, briefly to describe the problems which confronted Arnold (e.g., the growth of rationalism in Biblical criticism, popular disaffection toward the Church of England, and exclusively secularistic thinking in politics), and then to expound the solutions which he proposed. A concluding section of each chapter is devoted to the results of his work and the continuation of some features of it by later writers in the Victorian period. Because the historical significance of Arnold's ideas depends in part on whether (and how far) they were influential, an account of his influence on certain arbitrarily selected well-known Victorians is included. The reactions of Arnold's contemporaries to his work have also been sampled. Finally, instances have been noted in which his recommendations were anticipatory of legislation or later thinking on the subjects he treated.

The analysis of Arnold's views shows that his religious liberalism may best be described as "concessive." With a definite practical goal in mind--the preservation of Christian belief--Arnold gave up what he took to be indefensible religious outworks (i.e., authoritative claims for the Bible and the Church). Next it appears that the relationship between Arnold's religious and political ideas was that between a theory and a plan of action. Reading the Scriptures as a source of moral guidance, he was conscious of the deficiency of the social institutions of his day and the separation of religion from everyday life. The chief result was his advocacy of the Christian state in which religious principles would be operative in politics.

Arnold's religious and political ideas, though not much accepted in his own time, were deeply influential on Victorian liberals of a later day. The thinking of Matthew Arnold, Arthur Hugh Clough, Thomas Hughes, Arthur Penrhyn Stanley, Benjamin Jowett, Frederick Temple, W. E. Forster, J. P. Gell, and W. D. Arnold, in varying degrees, was strongly colored by the religious and political teachings of Thomas Arnold.

Microfilm \$3.50; Xerox \$12.40. 272 pages.

LIBRARY SCIENCE

FICTION IN PUBLIC LIBRARIES OF THE UNITED STATES, 1876-1900.

(L. C. Card No. Mic 60-2513)

Esther Jane Carrier, Ph.D.
University of Michigan, 1960

The purpose of this study has been to present a survey of the attitudes of librarians and the policies of public

libraries in the United States toward fiction during the years 1876 to 1900. The chief sources used in obtaining this information were the *Library Journal* and *Public Libraries*. A brief survey of contemporary literary opinion for a selected group of authors, representing the various types and levels of fiction whose value was being debated by librarians, was made, to demonstrate to what extent there was agreement between librarians and contemporary literary opinion. Emphasis was placed on the reviews of

the following magazines: Athenaeum, Atlantic Monthly, Critic, Dial, Harper's New Monthly Magazine, Literary World, and Nation.

Since the historical predecessors of the early public library and the acceptance of fiction in the American cultural pattern had a significant influence on the place of fiction in the modern public library movement, a brief summary of these factors was presented to set the context for the discussion.

During this period there was only one American librarian who strongly recommended the exclusion of all fiction from libraries. The major discussion evolved around the differences of opinion concerning what the purposes of a public library should be, which of course would determine the kind and amount of fiction to be supplied, and what qualities were required in the books themselves to give them the values necessary to meet the purposes for which they were provided. On two points there was general agreement among librarians: (1) no immoral books should be supplied; and (2) libraries should attempt to lead their users to a higher reading level. The differences of opinion arose concerning what constituted immorality in books, and on what beginning level books should be provided. Especially in regard to fiction for young people was the need for supplying books of a high quality and for developing their reading taste stressed.

A brief discussion of book selection policies and of the guides available was introduced. Various methods considered as useful aids toward reading improvement were also mentioned.

The controversies which arose over the fiction supplied by the Boston Public Library and the Carnegie Free Library, Allegheny, Pennsylvania, were cited as illustrations of the type of public criticism library administrators had to face.

Two major types of fiction were criticized during this period: The popular domestic and sensational novel in the earlier years, and the realistic novel in the later. Although the majority of librarians supported the more critical attitude toward fiction, a study of the popular literature of the day exonerates them, for the most part, of the charge of being over-critical. Their opinions were generally supported by the literary critics of the day. However, a difference of opinion was also found among the reviewers, so that both the librarians approving and disapproving of a book or author could usually find reviews to support their opinion. The attack of librarians on books for their immoral aspects received somewhat less support from literary critics. In the area of fiction for young people, librarians often demonstrated more leadership in demanding books of a better quality than did the reviewers.

During these years, the discussion of fiction developed into many expressions of personal opinion, which became increasingly contentious and decreasingly significant as a contribution to library science. No solution to the problem could be found then, nor has it in the years which have followed. Most librarians were following something of a compromise policy by attempting to supply the best books their users would read.

Microfilm \$7.50; Xerox \$26.80. 592 pages.

A VOICE FOR FREEDOM: THE SIGNAL OF LIBERTY, 1841-1848.

(L. C. Card No. Mic 60-2543)

John Edgar Kephart, Ph.D.
University of Michigan, 1960

The purpose of this study has been to analyze and evaluate the Signal of Liberty in terms of format, content, and financial operation, and to determine the opinions and attitudes of the editors, Theodore Foster and Guy Beckley, and their activities in publishing the paper.

The Signal of Liberty was the official newspaper of the Michigan State Anti-Slavery Society and of the Michigan Liberty Party from April 28, 1841 through February 5, 1848. As such, it contained primarily articles designed to further the cause of abolitionism in Michigan. But, in addition, articles were published to meet the paper's secondary purpose as a general family newspaper.

Following the pattern of a previous Michigan anti-slavery publication, the Signal experienced financial difficulties during the whole period of its issuance. The publishers used various means to put the paper on a sound financial basis, but were never successful.

Theodore Foster was editor in chief of the Signal. He was also active in politics and advocated reform in many areas of public and government morality. In the Signal, he expressed his opposition to slavery, drunkenness, and other mid-nineteenth century vices, as well as his interest in correcting errors in government.

Associated with Foster in publishing the Signal was the Reverend Guy Beckley, an ordained Methodist Episcopal minister. He had been active in the anti-slavery cause as a lecturer for the American Anti-Slavery Society in New England and New York, and later became known for similar work in Michigan. Beckley's main contribution to the Signal was his faithful financial support, without which the paper could not have been published regularly.

The Signal, as the official voice of the Michigan Liberty Party, demonstrated the progress of that movement. The high expectations of the party during the 1840's did not come to fruition, for conflicting views arose about the proper issues to be included in the party's platform. Foster believed that the issue of slavery alone was inadequate to draw voters to the party and proposed that other issues be added to the platform. Beckley went one step further and agreed to cooperate with any man who was truly anti-slavery whatever his party. But other Liberty men were determined that the party should be monolithic. This controversy, with the rise of abolitionist feeling among the radical Whigs and Democrats led to the collapse of the Liberty Party.

It is concluded from this study that the Signal of Liberty was a reliable and effective family newspaper as well as a voice of abolitionist thought in Michigan. It served its turn in the development of the radical thought which eventuated in the formation of the Republican Party. Both Foster and Beckley deserve recognition for their part in the growth of Liberty doctrines in Michigan.

Microfilm \$3.15; Xerox \$11.05. 241 pages.

MATHEMATICS

ON OPERATORS RELATED TO NORMAL OPERATORS

(L. C. Card No. Mic 60-2572)

Joseph Gail Stampfli, Ph.D.
University of Michigan, 1960

The purpose of this paper is to study two classes of operators on a Hilbert space. The first class is generally termed subnormal; more precisely, an operator T on a Hilbert space H is subnormal if there exists a Hilbert space K containing H and a normal operator B defined on K such that $Bx = Tx$ for every $x \in H$. The second class consists of those operators for which a positive integral power is normal.

The previous remarks should indicate superficial connections between the operators investigated in this paper and normal operators. Less trivial relations between these groups will be mentioned later.

The paper contains an alternative characterization of subnormal operators to one of Halmos: namely T is subnormal if and only if T is the limit of normal operators in the strong operator topology. If the underlying Hilbert space contains a cyclic vector, a representation of a subnormal operator as a multiplication operator on a space of square integrable functions is obtained. Completely continuous and scalar operators are shown to be subnormal if and only if they are normal.

The concluding results on subnormal operators concern their relation to the spectra of their normal extensions. Thus if T is subnormal with normal extension B , then the spectrum of B having no interior and not separating the plane implies that T is normal. If the spectrum of B has two dimensional measure zero, then T is normal if and only if the residual spectrum of T is empty. Finally, if the spectrum of B is two dimensional Lebesgue measure in the neighborhood of a point, then the residual spectrum of T is not empty.

For an operator in the second class, that is an operator, a positive integral power of which is normal, the main result is a representation of the underlying Hilbert space as a space of square integral functions, with respect to which the operator is super diagonal (this generalizes a well known theorem from finite dimensional spaces). It is shown that any operator in this class (as well as its adjoint) is the limit of spectral operators in the strong operator topology, although the given operator need not be spectral. A necessary and sufficient condition that such operators be normal is obtained. Finally, it is shown that any operator in this class possesses a proper invariant subspace.

This study by no means exhausts the problems connected with operators in either class but the results obtained do inform us as to the general structure of these operators. Microfilm \$2.50; Xerox \$3.00. 45 pages.

RADIAL CLUSTER SETS AND THE DISTRIBUTION OF VALUES OF MEROMORPHIC FUNCTIONS

(L. C. Card No. Mic 60-2589)

William Blauvelt Woolf, Ph.D.
University of Michigan, 1960

This paper is devoted to an investigation of the behavior near a singularity of a function $w = f(z)$ meromorphic in the unit disk. Particular emphasis is placed on the problem of deriving meaningful results for non-isolated singularities.

Chapter I is devoted to tracing the background of this study from the classical theorems of Weierstrass and Picard to the definitions of the cluster set and various subsets thereof. The cluster set, $C(f, P)$, of $f(z)$ at P is defined as the set of all points w which are limit points of sequences $f(z_n)$ for which $z_n \rightarrow P$, where $|z_n| < 1$. The radial cluster set, $C_\rho(f, P)$, of $f(z)$ at P is defined as that subset of $C(f, P)$ formed by restricting z_n to lie on the radius drawn to P . For an arbitrary subset E of $|z| = 1$, the radial boundary cluster set modulo E , $C_{R-E}(f, P)$, of $f(z)$ at $P = e^{i\theta_0}$ is defined as the intersection over all $\eta > 0$ of the closures of the unions $\cup C_\rho(f, e^{i\theta})$ for $0 < |\theta - \theta_0| < \eta$, $e^{i\theta} \notin E$. If E is empty, the set is written $C_R(f, P)$.

Chapter II reviews the concept of capacity and adapts techniques of Lohwater and a theorem of Lindelöf to prove that, if $f(z)$ is meromorphic in $|z| < 1$, then $f(z)$ assumes infinitely often in every neighborhood of a singularity P on $|z| = 1$ every value of $C(f, P) - C_R(f, P)$, with the exception of at most two values. Every such omitted value is an asymptotic value of $f(z)$ at P . This extends the classical theorem of Gross and Iversen.

In Chapter III, the principal result of the thesis is proved, based in part on results of Ahlfors in the theory of covering surfaces, and in part on properties of sets of capacity zero detailed by Evans. The main theorem states that, if $f(z)$ is meromorphic in $|z| < 1$, E is of capacity zero, P is a point of $|z| = 1$, and S is any component of $C(f, P) - C_{R-E}(f, P)$, then $f(z)$ assumes every value of S , save at most two, in any neighborhood of P . Every such omitted value is an asymptotic value either at P or at a sequence of boundary points having P as limit point.

The strength and significance of these results lies in their application to cases where the singularities are non-isolated, and, in particular, to the case that $|z| = 1$ is a singular line.

Microfilm \$2.50; Xerox \$3.00. 33 pages.

MINERALOGY

ULTRAVIOLET PIEZOBIREFRINGENCE OF DIAMOND

(L. C. Card No. Mic 60-2519)

Malcolm Alvin Conrad, Ph.D.
University of Michigan, 1960

Ultraviolet Piezobirefringence of Diamond describes the first quantitative determination of the stress-optical constants of a crystalline material in the ultraviolet part of the spectrum. The constants relate birefringence to the stress which produces the directional change in the indices of refraction and are, therefore, piezobirefringence constants. Similar constants on noncrystalline materials have been called photoelastic constants.

A crystallographically oriented diamond sample was subjected to calibrated unilateral stresses. Linearly polarized light was passed through the specimen, an analyzing polar, and a monochrometer. The amount of light

passing through the system while the sample was being subjected to a given stress was electronically recorded. The birefringence produced in the sample was computed from the stress value versus recorded amplitude data. A study of frictional losses in the stress apparatus demonstrated that friction may introduce large errors in stress-optical observations.

Piezobiabsorption was investigated and no observable directional variation of transmission was produced by obtainable stresses. The piezobirefringence constants of diamond $2q_{1212}$, $q_{1111}-q_{1122}$, and $1/2(q_{1111}-q_{1122}+2q_{1212})$ were found to be equal, within experimental error, to $-3.55 \times 10^{-4} \text{ cm}^2/\text{dyne}$ from 3342 to 5462 Å. The redundant constant $1/2(q_{1111}-q_{1122}+2q_{1212})$ is included because it adds validity to the other constants. Because of its low anisotropy, diamond may be considered, as a first approximation, to be a negative uniaxial crystal when subjected to any unilateral stress.

Microfilm \$2.50; Xerox \$3.00. 56 pages.

MUSIC

PRINTED ENGLISH LUTE INSTRUCTION BOOKS, 1568-1610. (VOLUMES I AND II).

(L. C. Card No. Mic 60-2514)

William Sherman Casey, Ph.D.
University of Michigan, 1960

The purpose of this study is threefold: (1) to provide a compendium of the instructions for playing the lute and for reading lute tablatures that are contained in the printed English lute instruction books of the late sixteenth and early seventeenth centuries, (2) to present the collection of music from one of the books in both tablature and in modern notation, and (3) to provide analyses of representative compositions from this collection.

In the introductory chapter, the English system of lute tablature is described, and the advantages and limitations of reading from tablature are discussed. Also, the method used in transcribing the tablatures into modern notation is explained, and the author's reasons for making the transcriptions suitable for performance on the modern classical guitar are given.

The second chapter deals with the verbal instructions and accompanying musical examples contained in the five extant lute books printed in England between the years 1568 and 1610, those of Le Roy (1568 and 1574), Barley (1598), Robinson (1603), and R. Dowland (1610). The instructions in each work are described briefly in turn; then the instructions from all of the books relating to the same

topics, such as tablature and fingering, are grouped together and treated in separate units.

In the final chapter, the collections of music in four of the five lute books are described briefly, while Robinson's collection is described in detail, and analyses of representative compositions from his collection are given as an aid to understanding not only Robinson's music but lute music of this period in general.

Robinson's compositions are treated in groups according to types, such as the psalm tunes, the duets, and the variations; or according to the number of strains or sections which make up the composition. Within each group the pieces are discussed in the order of increasing difficulty of performance.

The coordination between structural elements and tonality, or the tonal relationships that exist between strains or sections, are dealt with largely in terms of modern musical theory, at least with respect to the major and minor modes and tonic and dominant harmonies.

Volume II provides the complete collection of music from Robinson's Schoole of Musicke in a reproduction of his tablature with the transcription of the tablature in modern notation on a parallel line below. The transcriptions are designed for the guitar, but they may be played on any keyboard instrument. Either lutenist or guitarist may play from the tablature, but in doing so, the latter will need to tune his G string to F-sharp.

An appendix, also in Volume II, contains a facsimile reprint of the Schoole of Musicke, including both text and music.

In following the instructions while playing the numerous accompanying examples on a guitar tuned as a lute, and in proceeding from the simpler to the more difficult compositions in the collections of music, particularly that of Robinson, the writer's experience leads to two conclusions: the lute instruction books printed during the period known as the "Golden Age" of English lute music provide the best means of acquiring the techniques needed for playing this music and for reading the tablature notation in which it was written; and of all modern instruments exclusive of the lute itself, the guitar is best fitted for the performance of lute music. Microfilm \$3.15; Xerox \$11.05. 243 pages.

VARIAZIONI: FOR LARGE ORCHESTRA.

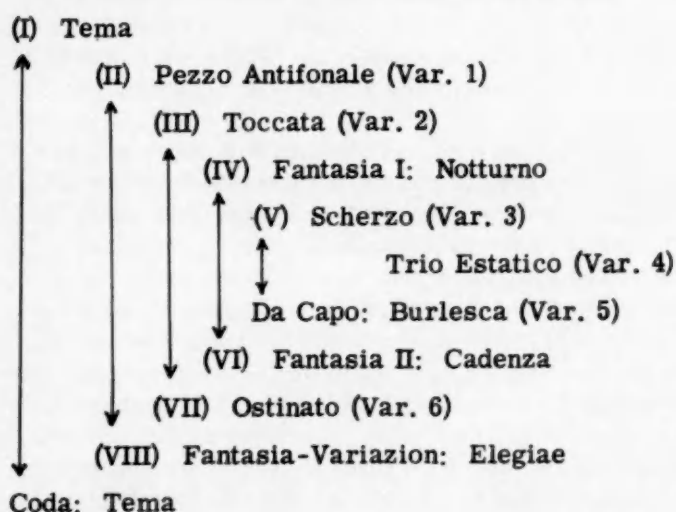
(L. C. Card No. Mic 60-2522)

George Henry Crumb, Jr., A.Mus.D.
University of Michigan, 1960

The idea of writing a set of orchestral variations occurred to me during the period in which I was sketching a violin concerto. "Variazioni" is actually an offshoot of the projected concerto since much of its material was originally destined for that (as yet incomplete) work. The composition of my "Variazioni" was finished in July, 1959, and the orchestration completed by the following September.

In its formal structure "Variazioni" does not literally follow the conventional pattern (i.e., theme followed by a number of variations and usually concluding with a coda section) but rather adds another dimension in the form of fantasy-pieces which have the function of "digressions." By the title "Fantasia" I designate a movement which is independent of formal associations with the theme whereas the structural basis of all the variations derives from the original theme. The formal structure of the theme - a simple A-B-A-B-Coda design - is in fact the only aspect of the theme which is consistently evident in the variation movements.

The over-all sequence of movements in my "Variazioni" is arranged in cancrizan-form, i.e., each piece in the first half of the work has its counterpart in the second half, thus giving a symmetrical form to the whole:



The centerpiece of the scheme is the Trio Estatico which differs from the other variations in that it quotes in full

the melodic outline of the original theme (a twelve-tone row). Thus a strong association is effected between the center and two outer movements of the work. The final movement rounds out the whole by combining the three distinct entities: theme, variation and fantasy.

The harmonic and melodic organization of "Variazioni" is not based on a strict twelve-tone logic although the theme itself is constructed on a twelve-tone series. It is true that much of the material in the work can be related to some combination inherent in the row (e.g., in the Pezzo Antifonale, which is based on a chord derived from notes four through seven of the original series), but nevertheless the problem of unity has been approached chiefly through formal structure and the free use of associative material rather than through total chromatic integration.

The orchestration of my "Variazioni" posed interesting problems owing to the rhythmic complexity and variety of texture in the music. My primary objectives in scoring the work were clarity and diversity of color. Much of the score has a soloistic or chamber-music quality, and all opportunities for color-effects were carefully considered.

Although the work demands a considerably enlarged orchestra, the full weight of the ensemble is felt in only three of the eight movements. The idea of smaller orchestras existing within the larger has been exploited for the purpose of achieving maximum contrast in color and texture. Virtually each movement has its own specific orchestra (e.g., Pezzo Antifonale: strings alone; Fantasia II: percussion with harp, celesta and mandoline); only the final movement actually employs all the instruments called for in the score.

As regards style, I consider that my "Variazioni" represents an important phase in my development. The *sine qua non* of my score is, of course, the music of Luigi Dallapiccola; I also feel a debt to Alban Berg and (perhaps to a less extent) to Anton Webern.

My work is dedicated to my friend Rolf Gelewski, who, aside from my teacher, Ross Lee Finney, has probably had the greatest influence on my musical convictions. The five bar introduction which precedes the theme is based on the musical letters (according to German spelling) of our combined names and is intended to make the dedication an integral part of the work.

Microfilm \$2.50; Xerox \$4.80. 94 pages.

THE EFFECTS OF BACKGROUND MUSIC ON READING COMPREHENSION AND THEIR RELATIONSHIP TO VARIOUS OTHER CHARACTERISTICS IN SIXTH GRADE STUDENTS

(L. C. Card No. Mic 60-2607)

James Parker LaBach, Ph.D.
Syracuse University, 1960

Purpose

The purpose of this experiment was the investigation of the effects of employing selected serious music of a relaxing type as a background during a reading comprehension test.

Procedures

A total of 476 sixth grade children were given two equivalent forms of a standard reading comprehension test. Tape recorded music was employed with one form of the test. The proportionate difference between the two test scores was calculated for each individual. The distribution of these differences was then tested for significance.

Each individual's IQ score and parent's occupation were obtained from school records. A questionnaire was used to obtain information about the subjects' listening habits and attitudes towards the use of background music with the reading test. Multiple regression techniques were used to determine the existence of any significant relationships between any of these factors and the gain or loss in reading test score with background music.

At the conclusion of the testing session in which music was used a tape consisting of short excerpts from the test music intermingled with other music of a similar type was utilized to ascertain the subjects' ability to recognize music played during the test.

Results

Use of the t-test at the .05 level of significance indicated that the background music had no significant effect on the reading test scores. Test scores tended to be higher on the second form of the test whether or not music was used.

No significant relationship was found between gain or loss in test scores with music and socio-economic status indicated by parental occupation, IQ scores, normal reading comprehension level, reported habits of reading with music at home, or attitudes towards the use of music with the test.

The subjects did show a very significant ability to recognize short themes from the test music when, intermingled with other thematic material, they were played after the test.

Conclusions

1. Selected relaxing background music did not tend to distract sixth grade children in a reading comprehension testing situation.
2. Distraction resistance did not appear to be significantly related to socio-economic status, intelligence, reading comprehension level, habits of reading or studying with music at home, or reported opinions about the use of music with the test.
3. Most of the children liked the music used with the test.
4. The significant incidence of ability of the subjects to recognize thematic material used during the test when played to them afterward is evidence that musical learning may take place when background music is employed. The long range possibilities of aesthetic values to be derived from background music have not been properly investigated as yet. The feasibility of such investigation is indicated by the results of the present study.

Microfilm \$2.50; Xerox \$7.00. 148 pages.

THE MASSES OF JOSQUIN DES PREZ. (PARTS I-III).

(L. C. Card No. Mic 60-2548)

John Harrison Lovell, Ph.D.
University of Michigan, 1960

Josquin des Prez was born about the year 1440 in northern France. The composer lived several years in Italy at the height of his career. He returned to France, where he was *maître de chapelle* to Louis XII until the king's death in 1515. Josquin died at Condé, August 27, 1522. An exacting and meticulous craftsman, Des Prez was the foremost composer of his generation. His chansons, motets, and Masses were widely disseminated in printed works and manuscripts. His style combines the brilliant structural techniques developed in the Low Countries and the harmonic and melodic warmth fostered by the Italians.

Twenty complete Mass cycles are attributed to Josquin. Seventeen of these were printed by Ottaviano Petrucci in three separate volumes of Masses devoted exclusively to Des Prez. The first book appeared in 1502, the second in 1505, and the third in 1514. Two more cycles were printed posthumously by Johannes Ott. The *Missa Allez regretz* is found only in manuscript but is probably a genuine work by Des Prez.

Part I presents the background to the Masses of Josquin des Prez. The few biographical facts known about the composer are given with a discussion of his stature and fame in later generations. The evolution of the cyclic Ordinary of the Mass is briefly outlined with musical examples. The original sources of Josquin's Masses are discussed, as well as the general characteristics of text, number of parts, ranges, clefs, meter, mode, and length. The twenty cycles are classified under four general headings, which govern the structural presentations of Part II.

The basic structural plans of the twenty Masses are examined in Part II. The first classification, the tenor *cantusfirmus* Mass, contains six works that present borrowed pre-existent material in the tenor throughout most of the cycle. Five Masses are based on the paraphrase of plainchant. The third category contains five works that illustrate steps taken in the direction of the parody Mass. The last group of four cycles presents Masses based on the composer's own inventions.

The style of Josquin, as exemplified by his complete musical settings of the Ordinary of the Mass, is examined in Part III. The analyses concentrate upon imitative techniques and their relationship to texture. The majority of sections in the Masses of Des Prez is scored for four parts. This basic texture is first discussed in relation to tenors that move in long note values. Four-part writing with similar motion in all parts is presented next, and then the use of mottos, other introductions, episodes, and codas. Separate chapters are devoted to the analyses of duets and of trios. A final analytical chapter describes the few instances in which the four parts are expanded to five or six either by canonic means or the addition of one or two extra parts.

The Masses of Josquin exhibit immense variety of musical invention. Each cycle, however, is controlled by some rational principle. Sectional interludes in reduced texture that appear mostly in the Sanctus and Agnus Dei

present lively small polyphonic forms. These duets and trios were not found to differ significantly from the introductions and episodes that occur in four-part writing. The style of Josquin includes the parallelism derived from fauxbourdon, homophonic passages, free counterpoint, free imitation, strict imitation, and canon. The composer's fondness for repetitions, either as sequence or as

ostinato, appears in nearly every Mass. Ostinato, indeed, is the dominant principle in at least three cycles.

The Masses of Des Prez sum up the achievements of his own generation and point to future developments in Renaissance polyphony. Each cycle represents an eloquent testimonial to the profound genius of its creator.

Microfilm \$6.60; Xerox \$23.40. 520 pages.

PHARMACOLOGY

PROTECTION BY TRANSPLANTED HEMIC CELLS AGAINST THE TOXIC AND LETHAL EFFECTS OF RADIATION AND POLYFUNCTIONAL ALKYLATING AGENTS

(L. C. Card No. Mic 60-1955)

Joseph Winston Byron, Ph.D.
The University of Buffalo, 1960

Homologous bone marrow transplantation was found to protect Swiss mice against the toxic effects of nitrogen mustard. Homologous thymic lymphocytes, homologous spleen cells, homologous lymph nodes cells, or heterologous thoracic duct lymphocytes were unable to protect animals under the same condition. The latter mentioned cells were also unable to protect mice against lethal doses of radiation while homologous bone marrow cell suspensions were effective. Protective effect of bone marrow against toxic doses of chlorambucil could not be investigated because chlorambucil killed mice by its convulsive effect before bone marrow depression could have developed. Convulsive effects due to chlorambucil could be modified by the administration of sedatives. Toxicity due to chronic administration of non-convulsive doses of chlorambucil could not be prevented by homologous bone marrow treatment. Evidence was presented to indicate a cumulative mechanism in the central nervous action of chlorambucil and a tentative hypothesis was advanced to explain this mechanism. The significance of bone marrow treatment as an aid to chemotherapy of neoplastic diseases is discussed. Microfilm \$2.50; Xerox \$7.20. 152 pages.

SOME OBSERVATIONS ON THE NEURAL MECHANISMS OF MORPHINE ANALGESIA

(L. C. Card No. Mic 60-2538)

Jane Elizabeth Heng, Ph.D.
University of Michigan, 1960

The purpose of this investigation was to study the effects of morphine upon the central nervous system of the dog to learn more about the sites and the neural mechanisms of its analgesic action. In order to study the effects of morphine upon evoked potentials in the primary and secondary pain pathways, the tooth pulp was chosen as a relatively unique system of somatic pain. As a control

preparation potentials were evoked from stimulation of the sciatic nerve which served as a source of touch and proprioception. The action of morphine upon the reaction component produced by single shock and repetitive electrical stimulation of the tooth pulp was determined in dogs with chronically implanted tooth electrodes. Cortical recruiting responses were produced by stimulation of the diffusely projecting thalamic nuclei.

In most of the acute experiments unanesthetized mongrel dogs were immobilized with decamethonium and placed on artificial respiration. Amalgam fillings were placed in the canine tooth for single shock electrical stimulation once every 4 seconds. Monopolar cortical or bipolar brain stem recordings were used. All sites were verified by gross inspection and/or histologically. Blood pressure was recorded from the femoral artery. Doses of 2 to 10 mg/kg of morphine sulfate and 1 to 2.5 mg/kg of nalorphine hydrochloride were given intravenously.

Morphine did not depress the amplitude or latency of the potentials in the direct primary afferent pathway from the tooth pulp in the contralateral coronal gyrus or nucleus ventralis posteromedialis and medial lemniscus.

The effects of morphine on the secondary pathways in the brain stem were complex. The potentials evoked from the tooth were usually enhanced in the areas surrounding central grey, some of the diencephalic nuclei, and in some of the medullary reticular areas, but occasionally were depressed or at other times were unaffected. The latencies of responses in nucleus medialis dorsalis were prolonged in spite of an enhancement in amplitude. Frequently an early depression within the first 10 minutes after intravenous administration of morphine was associated with a marked fall in arterial blood pressure. Upon return of the blood pressure toward normal, a subsequent enhancement of the potential occurred.

In the majority of experiments morphine had no effect upon the cortical potentials evoked by stimulation of the sciatic nerve.

Single shock electrical stimulation of the tooth pulp in human volunteers produced painful sensations.

In dogs with chronically implanted electrodes morphine produced an infinite increase in threshold to single shock stimulation of the tooth pulp. Nalorphine produced a partial reduction in the elevated threshold. Recovery was complete within 24 hours. A significant increase in threshold to repetitive stimulation of the tooth pulp was observed following morphine. This elevation was more significant statistically when the effects on the morphine-treated animal were compared to the alert animal. Nevertheless,

there was indication that the morphine was more effective than a drowsy state in producing an increase in threshold to repetitive painful stimulation.

Morphine in doses of 0.2 to 10 mg/kg given intravenously produced a definite enhancement of cortical recruitment.

An incidental finding was that nalorphine produced a significant elevation in blood pressure above control in some animals following morphine.

It is concluded that the neural mechanisms of morphine analgesia of tooth pulp pain are complex. Apparently the primary pathways are not depressed. Many of the secondary pathways showed a definite enhancement, but occasionally a depression or no effect following morphine was seen.

Microfilm \$2.50; Xerox \$6.60. 136 pages.

SOME PHARMACOLOGICAL ASPECTS OF THE NEURONALLY ISOLATED CEREBRAL CORTEX

(L. C. Card No. Mic 60-2560)

Richard Howard Rech, Ph.D.
University of Michigan, 1960

The neuronally isolated cerebral cortex of dogs was investigated to determine its value in elucidating direct cortical effects of pharmacological agents. In addition, topical application of chemical substances to the isolated and intact cortex was studied by comparing effects thus obtained with those of systemic administration. The suprasylvian gyrus was isolated in animals anesthetized with thiopental. The pial vasculature remained intact. After recovery from anesthesia the animal was immobilized with decamethonium and given artificial respiration. Spontaneous and evoked electrical potentials were recorded from the isolated and nearby intact cortex. Recordings were also taken from measured depths of the isolated area.

The cortical island exhibited spontaneous electrical activity of the "suppression-burst" pattern, whereas intact areas showed EEG activation. The topical application of strychnine, d-tubocurarine, pentylentetrazol or picrotoxin to the isolated and neighboring intact cortex induced different electrical patterns not temporally related in the isolated and intact regions. Intravenous injection of pentylentetrazol or picrotoxin induced EEG patterns in the isolated and intact areas similar to those of Grand Mal seizures; moreover the electrical patterns in the isolated and surrounding intact cortex were temporally related. Intravenous administration of strychnine (up to 500 µg/kg)

and d-tubocurarine (up to 1 mg/kg) did not change the activity of the isolated area.

Topical application of physostigmine to the cortical island evoked an electrical pattern similar to EEG activation, but the intravenous injection of physostigmine produced this pattern only in the intact cortex. Combined application of strychnine and physostigmine caused an electrical seizure in the isolated region made up of short bursts and large waves. Atropine given intravenously abolished all the actions of physostigmine.

Chemically induced negative spikes in the island of cortex were "reversed" by gamma-aminobutyric acid (GABA) applied topically or given intravenously in large doses. Topical application of local anesthetics and trichloroacetic acid, application of pressure, and thermocoagulation also converted surface negative spikes to positive ones, but the potentials were greatly attenuated. Comparison of the negative potentials in the deeper layers after the application of GABA and heat showed little difference. The surface "dendritic" response, evoked in the isolated gyrus by single electrical shocks, was also "reversed" by GABA. A negative potential in deeper layers persisted after the topical application of 0.1% GABA, but 0.5% GABA resulted in reversal of the negative wave in all cortical layers.

The intravascular administration of epinephrine and serotonin initially depressed and later enhanced both chemically induced spiking frequency and the afterdischarge evoked by repetitive electrical stimuli. Norepinephrine was less effective in this regard but produced a greater increase in arterial blood pressure. Previous administration of phenoxybenzamine increased the initial depressant effect of epinephrine. Cholinergic agents also decreased the frequency of strychnine spiking, but this effect probably was due to a fall in blood pressure. The significance of the effects of the vasoactive agents was discussed.

It was concluded that the neuronally isolated cerebral cortex is a suitable test object for studying direct cortical effects of drugs. Activity induced by the topical application of pentylentetrazol and picrotoxin resembled the effects obtained by systemic administration. Nevertheless, strychnine, d-tubocurarine, physostigmine and GABA, given systemically in reasonable doses, did not evoke activity in the isolated cortex similar to that seen on topical application. Depth recordings indicated that volume conduction theory may not explain entirely the effect of GABA in reversing surface potentials. Only field potentials were recorded, which do not necessarily reflect the intensity of activity at any given level. The prolongation of electrical seizures by repeated administration of epinephrine appeared to be a direct cortical action.

Microfilm \$2.50; Xerox \$6.40. 135 pages.

PHILOSOPHY

A PHILOSOPHICAL ANALYSIS OF METAPHOR APPLIED TO GEORGE BERKELEY'S THEORY OF MEANING

(L. C. Card No. Mic 60-2580)

Elston Wells Van Steenburgh, Ph.D.
University of Michigan, 1960

Simile and metaphor are studied and used as a basis for interpreting the metaphysics of George Berkeley (1685-1753). The importance of the study arises from the fact that (A) simile and metaphor are not generally regarded as basic components in a philosophical theory of meaning, and (B) Berkeley's metaphysical conclusions are not generally regarded as resting upon a theory of meaning which permits use of simile and metaphor.

An account of meaning is developed in two stages. The first stage carries us to that point at which conceptual meaning and meaning in the sense of "purpose" are distinguished. Emphasis is given purposes of productive, as opposed to receptive, discourse. The broadest classification is other-regarding versus self-regarding purposes. Under the latter fall expression of thoughts, feelings, and attitudes without regard to the role of receiver. Under the former fall the intent to convey a conceptual complex to a receiver, to reinforce or alter his belief or the grounds of his belief, to reveal to and/or invoke in him feelings and attitudes, and to reinforce or alter his behavior. Specific purposes of productive discourse, and problems of identifying specific purposes, are not considered.

The second stage carries us to that point at which the notion of conceptual meaning is sufficiently clear for use in discussing literal and metaphorical meaning. Theories of the nature of concepts of Plato, Aristotle, John Locke and David Hume are characterized and later used to place Berkeley's own theory in proper historical perspective.

The nature of literal meaning is discussed, since any analysis of the nature of metaphor and simile presuppose it. Metaphor and simile are given a semantic characterization. Metaphor is shown to be compressed simile. Hence, similes may not be used in literal paraphrases of metaphors. Philosophical metaphors and almost all poetic or literary metaphors cannot in principle be adequately paraphrased in literal terms.

Our general conclusions are: (1) Berkeley's theory of meaning permits, with limitations, use of simile and metaphor, (2) Berkeley supports his major metaphysical theses by an appeal to his theory of meaning, and (3) the view that Berkeley is a non-systematic empiricist is false, since his theory of meaning, regarded as empirical, receives systematic employment by virtue of its analogical component.

Microfilm \$2.75; Xerox \$9.45. 209 pages.

TOWARD A THEORY OF LEGAL JUSTIFICATION

(L. C. Card No. Mic 60-2584)

Richard Alan Wasserstrom, Ph.D.
University of Michigan, 1960

The purpose of this study is to investigate the claim present in recent legal philosophy that a rationalistic or logical decision procedure is an inappropriate method of legal adjudication. The study examines the relationship between the thesis that the legal system ought to maximize satisfactions and the conclusion that a rationalistic decision procedure cannot successfully do so. The study seeks to determine which legal decision process would best enable the legal system to fulfill this utilitarian function of maximizing satisfactions.

The scope of the study is limited through the introduction of two assumptions: (1) The legal system analyzed is assumed to be devoid of all legislative rules of law and to possess only those rules of law made by the judiciary; (2) The desirability of the goal of maximizing satisfactions is assumed throughout.

The first portion examines those theories which deny that the legal decision process either is or can be a rule-applying procedure. The dependence of these theories upon two ambiguous concepts is discussed. The ambiguities are to be found in: (a) "legal decision procedure," which can denote either a process of discovery or a process of justification; (b) the phrase, "legal rule," which can refer either to a particular court decision, an ordinary rule of law, a meta-legal rule of decision, or a rule which announces the function which the legal system ought to fulfill. The first portion is also a critical exposition of existing analyses of the doctrine of precedent.

The second and largest portion of the inquiry is a detailed study of three possible logics of legal justification, and the manner in which they would operate in three idealized models of judicial decision procedure. They are: (1) The model of precedent, which is conceived of as containing one meta-legal rule of decision which states: The justification for any particular judicial decision consists in its deducibility from some extant rule of law. The model is found to be desirable because of the degree to which it makes antecedent prediction of judicial consequences possible and because it is conducive to an efficient adjudication of particular cases. It is rejected because it provides no substantive criterion by which criticism of existing rules of law is possible. (2) The variant models of equity which all have as their meta-legal rule of decision the prescription that each particular case is to be decided without regard for legal rules at all. Those sub-models of this group which insist that cases be decided non-rationally, i.e., by appeal to intuition or the sense of injustice, are rejected because an intuitive methodology is shown to be an inappropriate means by which to produce desirable decisions. The related theories, which base the

rejection of a rule-applying procedure upon the fact that some individual cases are unique, are rejected on the grounds that the distinction between these and other cases is untenable. (3) The model based upon a two-level logic of justification whose meta-legal rules insist that particular decisions be justified by appeal to the relevant legal rule and legal rules be justified by appeal to the function of the legal system. This proposed logic of justification is shown to produce that set of decisions which would be most justifiable on utilitarian grounds. It provides a means by which predictability is possible and also a means by which the material content of legal rules can be evaluated and altered.

The third and final portion of the study relates the two-level logic of justification to the major movements of contemporary Anglo-American legal philosophy. It concludes that: (a) If the discussion of a two-level logic is merely explicative of recent theories, then the most desirable judicial decision procedure is neither non-rational nor non-logical. (b) If these same theories imply a different procedure, then that procedure cannot effectively realize the utilitarian goal posited by these theories as desirable.

Microfilm \$3.20; Xerox \$11.05. 245 pages.

PHYSICS

PHYSICS, GENERAL

AN EXPERIMENTAL DETERMINATION OF THE MAGNETIC MOMENT OF THE PROTON IN UNITS OF THE NUCLEAR MAGNETON

(L. C. Card No. Mic 60-2510)

Harold Stephen Boyne, Ph.D.
University of Michigan, 1960

The magnetic moment of the proton μ_p has been measured in units of the nuclear magneton $\mu_n = (e\hbar/2M_p c)$. This determination can be achieved by measuring the nuclear magnetic resonance frequency of protons $\omega_p = (2\mu_p H/\hbar)$ and the cyclotron frequency of protons $\omega_c(H^+) = (eH/M_p c)$ in the same magnetic field. The ratio of these two frequencies yields, directly, μ_p/μ_n . However, in the present experiment it has been much more convenient to measure the ratio of the cyclotron frequency of hydrogen molecular ions, $\omega_c(H_2^+)$, and the nuclear magnetic resonance frequency of deuterons ω_D . The conversion of this measurement to the desired proton ratio presents no difficulties since it involves only very accurately known mass and nuclear moment ratios.

Hydrogen molecular ions are produced by electron impact ionization of hydrogen which is allowed into a highly evacuated chamber. The cyclotron resonance is detected by a power absorption technique that does not disturb the ion space charge distribution in the chamber. This technique also permits the experiment to be performed in a small region of magnetic field within which considerable homogeneity can be maintained.

The experiment is complicated by shifts which occur in the ion cyclotron frequency due to inhomogeneous static electric fields. These fields are produced both by space charge and by application of electric trapping voltages. The shifts are a function of the magnetic field intensity and are evaluated by an extrapolation procedure which requires an investigation of the dependence of the frequency ratio $\omega_D/\omega_c(H_2^+)$ on the magnetic field intensity.

The theory of ion cyclotron power absorption is presented. The results of calculations, originally developed by Franken and Liebes, pertaining to the magnetic field dependent frequency shifts are experimentally verified.

After correction for the electrostatic shift, the value obtained for the frequency ratio $\omega_p/\omega_c(H_2^+)$ is

$$\omega_D/\omega_c(H_2^+) = 0.857\,665 \pm 0.000\,010$$

$$(\pm 12 \text{ ppm}) \text{ (parts per million)} \quad (1)$$

The conversion of this quantity to the desired proton ratio introduces an error of less than 0.5 ppm and yields

$$\mu_p(H_2O)/\mu_n = 2.792\,83 \pm 0.000\,034 \quad (\pm 12 \text{ ppm}) \quad (2)$$

where the notation $\mu_p(H_2O)$ indicates that the nuclear magnetic resonance measurement was performed with a water sample. To obtain the magnetic moment of the free proton from the above ratio it is necessary to apply a diamagnetic correction appropriate to water: $(+26.2 \pm 0.1) \times 10^{-6}$.

This yields

$$\mu_p(\text{free})/\mu_n = 2.792\,90 \pm 0.000\,034 \quad (\pm 12 \text{ ppm}) \quad (3)$$

This value is to be compared with the published measurements of Sommer, Thomas, and Hipple; Collington, Dellis, Sanders, and Turberfield; and Trigger. A weighted average of their results, as determined by Cohen and DuMond, is

$$\mu_p(\text{free})/\mu_n = 2.792\,76 \pm 0.000\,03 \quad (\pm 10 \text{ ppm}) \quad (4)$$

The present determination (3) disagrees with this weighted average by 50 parts per million.

Microfilm \$2.50; Xerox \$4.80. 91 pages.

THE OPTICAL PUMPING OF HELIUM IN THE 2^3S_1 METASTABLE STATE

(L. C. Card No. Mic 60-2518)

Forrest Donald Colegrove, Jr., Ph.D.
University of Michigan, 1960

Optical pumping is a technique for aligning or polarizing free atoms by the action of a specially prepared beam of light. The method was first proposed by Kastler in 1950 and has since been exploited in many studies of the alkali

metals and mercury. Attempts to study other elements by this method have not been successful until the present work on the metastable 2^3S_1 state of helium. There are several effects connected with the optical pumping of this atomic system not associated with the earlier investigations.

In a discharge, helium atoms are excited to the metastable state with a random orientation of their electronic spins such that in a magnetic field the three magnetic sublevels are equally populated. The relative populations of the sublevels may be altered by optical pumping to produce an orientation of the spins. This is accomplished by inducing transitions to the 2^3P states with a beam of resonance radiation from a helium lamp. Some sublevels become more highly populated than others because the atoms absorb radiation from one direction only but may emit in all directions as they decay back to the 2^3S_1 state. The type and degree of orientation depends upon the direction of the resonant light relative to the magnetic field, its polarization, and the relative intensities of the two radiation components.

The resulting orientation is detected by observing the change in intensity of the transmitted pumping light when transitions between the sublevels are induced by a radio frequency magnetic field near the resonant frequency, $eH/2\pi mc$. The resonance signal obtained upon the destruction of the alignment by the radio frequency field is examined in detail. The resonance line shape exhibits a double maximum which is due to the quantum mechanical properties of a spin one system.

Under certain circumstances a change in the density of metastable helium atoms results in an inversion of the resonance signal. An analysis of this phenomenon shows it to result from different total absorption rates for each of the components of the resonant radiation.

The pumping time and relaxation time of the ensemble of metastable atoms are measured and found to be about 10^{-3} seconds and 2.5×10^{-4} seconds, respectively. The magnitude of the signal predicted from these two measurements is in very good agreement with experiment. Preliminary measurements of the cross section for destruction of metastables by impurities are also reported.

Microfilm \$2.50; Xerox \$5.00. 96 pages.

A METHOD OF OBTAINING AND ANALYZING TIME-RESOLVED INTENSITY PATTERNS OF THE RADIATION FROM VARIOUS REGIONS OF A VACUUM SPARK DISCHARGE.

(L. C. Card No. Mic 60-2541)

Herbert Whittier Jones, Ph.D.
University of Michigan, 1960

The purpose of this dissertation is primarily to describe the methods and equipment developed to measure the maximum intensities of spectral lines from various regions of a vacuum spark discharge, as a function of the discharge circuit parameters.

In the main study, the spark was produced in a cylindrically symmetric metal chamber evacuated to 10^{-4} mm Hg between quarter inch diameter carbon electrodes separated by a one-eighth inch gap. A 21.6 microfarad condenser bank charged to 10, 15, or 20 kilovolts was dis-

charged through a variable air-core inductance which could be set so that the discharge circuit inductance was 1.8, 11.4, or 43.6 microhenries. The breakdown of the spark gap was initiated by a "triggering spark" from the third electrode connected to the secondary of an ignition coil. The discharge current was of a damped sinusoidal form whose frequency was 5,190, 10,160, or 25,500 cycles per second, and the peak discharge current, i.e. the maximum current obtained during each discharge, varied from 6.75 to 61.6 kiloamperes -- depending on the circuit inductance and the initial charge on the condenser bank.

A simple imaging system before the spectrograph allowed light to be analyzed from selected narrow cross-sections of the spark gap. The amplified signal from a photomultiplier detector placed in the focal plane of the spectrograph when supplied to a cathode-ray-tube, furnished a display of the instantaneous intensity of the radiation which was then photographed. The total intensities (obtained by positioning the photomultiplier slit on a spectral line), the background intensities (obtained by positioning the slit just off the spectral line), and the line intensities (obtained by subtracting the backgrounds from the total intensities) of the lines C II 4267A, C III 4187A, C III 4647A, and C III 4650A are plotted as a function of peak discharge current using the circuit inductance as a parameter, for each of three regions of the spark gap -- the middle of the gap, the region close to the electrode which is initially the anode, and the region close to the electrode which is initially the cathode. The intensities were found to be greatest for the cathode region, somewhat less in the center region and least of all in the anode region. Typical oscilloscope patterns of the total light and background for spectral lines which reveal discernible differences for the three regions are shown. The instantaneous light output of the spectral lines was crudely half-sinusoidal and in phase with the discharge current, but decayed at a faster rate than the current, and the background light decayed even more rapidly yet. The background intensity rose more rapidly than the line intensity with increasing peak discharge current, and the line intensity did not increase much above that obtained at 30 kiloamperes and in some cases it even decreased at higher currents. Discontinuities in the plots are sometimes shown when the value of the inductance is changed. "Open-shutter" photographs of the spark were taken which revealed the irregularities of the discharge between the electrodes.

The necessity for temperature control of the spectrograph is shown together with a method of accomplishing it. A firing sequence to compensate for sputtering on the radiation exit window was devised, as was a method for checking the stability of the detector and recording system with "chopped light." The pumping speed of the vacuum system was measured and also the discharge circuit inductance.

The following problems, which are related to the principal investigation, were also studied: the effect of different sizes and shapes of carbon electrodes, and of different gap spacings; the use of metallic electrodes; and the substitution of a glass-wall chamber and an all-glass chamber.

Microfilm \$2.50; Xerox \$5.40. 110 pages.

ELECTRON SPIN-LATTICE RELAXATION IN PHOSPHORUS-DOPED SILICON

(L. C. Card No. Mic 60-2617)

Edward Henry Stupp, Ph.D.
Syracuse University, 1960

The electron spin - lattice relaxation times in phosphorus - doped silicon have been measured. The investigation was carried out over a magnetic field range of 0 to 11,000 oersteds, a temperature range of 1.2°K to 4.2°K, and a concentration range of 1×10^{14} P atoms/cc. to 3.5×10^{16} P atoms/cc. Three distinct τ_S ($\Delta m_S = \pm 1, \Delta m_I = 0$) mechanisms have been identified and they are characterized as follows: (1) $1/\tau_S[H^4, T]$. This mechanism is characterized by concentration independence, H^4 field dependence, and linear dependence on temperature. It dominates at high magnetic fields and low temperatures. (2) $1/\tau_S[T^7]$. This Raman type mechanism has a T^7 temperature dependence and is independent of concentration and magnetic field. It dominates at the higher temperatures. (3) $1/\tau_S[\text{conc.}]$. This mechanism is very likely a first order phonon process, depending linearly on temperature and going as $H^{-1/2}$. Its most distinguishing feature is a linear concentration dependence for concentrations below 10^{16} P atoms/cc. It dominates at low temperatures and low magnetic fields. The data for the horizontal mode processes ($\Delta m_I = \pm 1$) suggests that, between 2.16°K and 4.2°K, a Raman process dominates. In addition to field and concentration independence in this temperature region, the temperature dependence goes as $T^{0.5}$. τ_X ($\Delta m_I = \pm 1, \Delta m_S = \pm 1$) is the dominant horizontal relaxation process. At 1.25°K, another mechanism becomes dominant. While the large errors make it difficult to ascertain the nature of the mechanism, the results are not consistent with a quadratic field dependence of $1/\tau_X$. At low magnetic fields, concentration dependent τ_N ($\Delta m_I = \pm 1, \Delta m_S = 0$) and τ_X mechanisms arise due to an admixture of states which allows $1/\tau_S[\text{conc.}]$ also to induce $\Delta m_I = \pm 1$ transitions. When all the preceding mechanisms are properly superposed, their resultant agrees well with the experimental results except for a small discrepancy which shows up for dilute samples at 1.25°K. This discrepancy can be accounted for by introducing another mechanism. The possible theoretical origins of all the mechanisms are discussed.

Microfilm \$2.50; Xerox \$5.20. 103 pages.

PHYSICS, NUCLEAR

DIRECTIONAL CORRELATION OF GAMMA RAYS IN GERMANIUM 72 AND DYSPROSIUM 160

(L. C. Card No. Mic 60-2507)

Robert George Arns, Ph.D.
University of Michigan, 1960

The directional correlation of successive gamma rays has been the principal tool of low-energy nuclear physics for determining the spins of excited states and the multipole order of the emitted radiation. The gamma-gamma direc-

tional correlation experiment consists in measuring the coincidence rate between successive gamma rays as a function of the angle between their directions of emission. A method is outlined which facilitates the interpretation of directional correlation data when one or both of the emitted gamma rays are not of pure multipole order.

Directional correlation measurements were made on five cascades involving the gamma rays in Ge^{72} , and six cascades involving the gamma rays in Dy^{160} . The results are discussed in terms of the unified model as interpreted by Davydov and Filippov. Evidence is cited to support the existence of rotational levels in all non-spherical nuclei. It is shown that these levels may be interpreted as arising from the rotation of a non-axial ellipsoid.

The 0.835 Mev level in Ge^{72} is characterized as 2+. The 0.63 Mev gamma ray, a transition from the second 2+ level at 1.46 Mev, is mostly E2 with a small M1 admixture. The energy of these states, together with the observed transition probabilities, indicate that Ge^{72} deviates strongly from axial symmetry. The directional correlation measurements, together with the gamma transition intensities, favor spins of 2, 3, and 2 for the levels at 3.34 Mev, 3.32 Mev, and 3.04 Mev, respectively.

Dy^{160} is a strongly deformed nucleus and the ground state, 0.087 Mev level, and 0.283 Mev level form the 0+, 2+, and 4+ members of the ground state rotational band. The level at 0.964 Mev is characterized as 2+ and the transition from it to the 0.087 Mev level (0.877 Mev gamma ray) is mostly E2 with a small M1 content. The 0.298 Mev gamma ray is a pure E1 transition from the 2- level at 1.262 Mev to the 0.964 Mev level. The measurements favor a spin of 3 for the level at 1.359 Mev. The 1.175 Mev, 1.272 Mev, and 1.076 Mev gamma rays were found to be mostly dipole. The first five levels are interpreted as the 0+, 2+, 4+, 2+, 3+ rotational states of a non-axial nucleus. The latter two of these may also be considered as γ -vibrations. The results of the two interpretations are discussed.

Microfilm \$2.50; Xerox \$5.40. 106 pages.

THE STRUCTURE OF O^{19}

(L. C. Card No. Mic 60-2586)

Wentworth Williams, Jr., Ph.D.
University of Michigan, 1960

Purpose

Three low-lying levels had been observed in O^{19} prior to this investigation: a level, tentatively identified as the ground state, with a (d,p) Q-value of 1.730-Mev, and two excited states at 0.096-Mev and 1.470-Mev excitation, the second of which had been given an assignment of $J^\pi = 1/2^+$.

The purposes of this investigation were, therefore: first, to determine the parities and spins of known states; second, to search for new states at higher excitation energy and, if found, to determine their parities and spins; and third, to compare the observed O^{19} level structure with theory.

Outline of experiment

The $O^{18}(d,p)O^{19}$ reaction was employed throughout this investigation of O^{19} by directing the energy-analyzed 7.8-Mev deuteron beam from the University of Michigan 42" cyclotron onto thin, O^{18} -enriched LiOH targets mounted in the scattering chamber. The (d,p) reaction protons were momentum analyzed by a high resolution magnetic analyzer and detected by Kodak NTB and NTB-2 nuclear emulsion plates placed at the analyzer image plane. Most of the nuclear emulsion plates were scanned by a machine scanner with only limited hand scanning required to establish absolute peak intensities.

Experimental results

Two surveys, each of which were run at reaction angles of 15° and 45° and which would reliably detect group intensities >15 percent of the O^{19} ground state group intensity at 15° , yielded the following results. First, no O^{19} level was found between $Q = 1.730$ -Mev and $Q \approx 3.2$ -Mev; this confirms the ground state designation of the $Q = 1.730$ -Mev level. Second, two new levels were discovered in the region between the ground state and ~ 4.5 -Mev excitation at 3.14-Mev and 3.94-Mev; (d,p) Q -values of $Q = -1.41 \pm 0.02$ -Mev and $Q = -2.21 \pm 0.02$ -Mev, respectively, were established for these levels.

The results of the angular distribution and relative intensity studies are summarized in the following table in which the Butler radius is given in fermis ($f = 10^{-13}$ cm) and the angle is the reaction angle at which the intensity comparisons (to the ground state) were made. No consistent angular distribution was obtained for the first excited state.

State	E (Mev)	l_n	Radius (f)	Angle	Relative Intensity
Ground . . .	0	2	5.1	—	1
First	0.096	—	—	30°	0.027 ± 0.003
Second . . .	1.470	0	5.7	15°	4.82 ± 0.25
3.14-Mev .	3.14	0	4.5	15°	0.35 ± 0.05
3.94-Mev .	3.94	1	4.9	15°	0.48 ± 0.05

Conclusions

On the basis of these and other angular distribution studies, a comparison between theoretical and experimental relative reduced widths, and the known O^{19} β -decay scheme and first excited state life time, the following level designations have been assigned: ground state, $J^\pi = 5/2^+$; first excited state, $J^\pi = 3/2^+$; second excited state, $J^\pi = 1/2^+$; 3.14-Mev state, $J^\pi = 1/2^+$; and 3.94-Mev state, $J^\pi = 1/2^-$ or $3/2^-$.

Neither the 3.14-Mev nor the odd parity 3.94-Mev can be accounted for by existing calculations. However, they can be qualitatively understood by considering sets of jj -coupled configurations comprising a $1/2^+$ state wave function appropriate to an excitation energy of ~ 5 -Mev for the 3.14-Mev state and of core-excited, jj -coupled configurations composing a $1/2^-$ or $3/2^-$ wave function for the 3.94-Mev state.

It seems unlikely that the low-lying $7/2^+$ and $9/2^+$ states predicted by theory can be observed by stripping.

The observed excitation energies of the first excited $3/2^+$ state and the second excited $1/2^+$ state are not in agreement with the theoretical predictions.

Microfilm \$2.50; Xerox \$5.00. 100 pages.

PHYSICS, SOLID STATE

IRRADIATION EFFECTS IN PLASTICS

(L. C. Card No. Mic 60-1724)

Robert Edward Barker, Jr., Ph.D.
University of Alabama, 1960

Optical, electron paramagnetic resonance and diffusion measurements have been carried out on x-irradiated Lexan (a polycarbonate). There is a broad band of increased optical absorption in the vicinity of 0.4μ and a single broad EPR absorption of about 13 ± 3 gauss line width. The results indicate that the observed x-ray induced paramagnetic and color effects are due largely to the same types of centers. An optical method for measuring the diffusion coefficient for O_2 in Lexan is presented and the results of such measurements show that the temperature dependence of this diffusion coefficient is described by an Arrhenius type relation in the temperature range between 0°C and 130°C . Evidence is presented to show that O_2 diffusing into the irradiated polymer will remove the color centers responsible for the major part of the x-ray induced effects in the visible spectrum, thus correlating the optical, EPR, and diffusion data.

Microfilm \$2.50; Xerox \$5.00. 97 pages.

NEW METHODS FOR THE VISUALIZATION OF ULTRASONIC FIELDS*

(L. C. Card No. Mic 60-2642)

Charles Wesley Hoffman, Ph.D.
Temple University, 1952

Several new methods of ultrasonoscopy and ultrasonography have been found which represent a definite contribution to the techniques of ultrasonic field investigations.**

A thorough search of the literature has shown that an explanation of the phenomenon concerning the action of ultrasonic waves on photosensitive emulsions has not decided up to now whether it is a result of a primary interaction or of a secondary effect resulting from the heat generated in the detector. Ernst, for example, has shown that, under favorable ultrasonic conditions, pseudo-standing wave patterns can be represented ultrasonographically. But it is not absolutely certain that these are caused by a specific ultrasonic effect. There are

other possibilities, such as for example, ultrasonic fluorescence in liquids. It also could be that the local heat developed in the ultrasonic field is a cause for the production of the latent image. Despite the investigations of Marinesco, Bergmann, Pinoir and Pouradier, the explanation of this phenomenon is not complete nor entirely convincing.

Under these circumstances, the author felt it worthwhile to investigate chiefly the known thermal effects of ultrasonics and to apply them to ultrasonoscopy and ultrasonography.

Preliminary experiments were made with certain thermographic substances which showed conclusively the possibility of using the known thermal effects for making ultrasonic field patterns visible. In view of the ultimate importance of this ultrasonic effect to science and industry, it was deemed necessary to pursue the investigations along broad lines of attack and the development of the following new methods resulted:

Thermo-chromotropic Method

The ultrasonic fields were made visible quite well on the basis of a color change from yellow to red by the local heating action on the chromotropic paper in the liquid. This method has the distinct advantage that bright light could be used during the test, and photographs (color and black-and-white) were taken.

Chemi-chromotropic Method

In this method the ultrasonic fields were made visible by the oxidation of a leukobase under ultrasonic irradiation. A disadvantage of this method was the inability to store leukobases for future use. The dye had to be used right after making the sensitized paper. There were some interesting phenomena associated with this method.

Stimulation or Phosphorescence Method

In this method the ultrasonic fields were made visible by intensifying the phosphorescence of special phosphors (called "thermostimulable" phosphors). This stimulation was produced by the local heating action of the ultrasonic waves. The phosphors must be excited by short wavelength radiation previous to usage and allowed to decay in phosphorescence until no light emission is apparent.

Quenching or Fluorescence Method

In this method, temperature-sensitive phosphors were used which fluoresce under continuous ultraviolet excitation. The ultrasonic fields were made visible by quenching this fluorescence. This quenching was produced by the local heating action of the ultrasonic waves. Although the work had to be done under ultraviolet radiation for phosphor excitation, photographs (color and black-and-white) of the fields have been taken. The effects on the field patterns of various plastic lenses have been investigated with the screen in horizontal, vertical and tilted positions.

Detonation Method

It has been shown that light is able to detonate nitrogen tri-iodide. Richards and Loomis and others have shown

that ultrasonic waves were able to detonate certain unstable substances (explosives). Eggert has reported a photographic printing method whereby a hardened cellulose paper, impregnated with finely dispersed nitrogen tri-iodide, was used as a light-sensitive material.

The methods mentioned above, evaluated for the material used, on the basis of sensitivity of the detector, clarity of pattern, time-lag of appearance, and ease of observation, lead to the following conclusions:

The Quenching Method is the best one because it is the fastest, gives a clear pattern, and responds to low intensity of ultrasonic irradiation.

The Thermo-chromotropic Method is not as fast as the Quenching Method but has all of its other advantages.

The Stimulation Method suffers in longer time-lag, low contrast, and requires a higher intensity of ultrasonic irradiation. This method, as well as the Chemi-chromotropic Method, is more cumbersome to use because its application requires complete darkness.

The Chemi-chromotropic Method did not give reliable information because the results were inconsistent. Microfilm \$2.50; Xerox \$5.20. 105 pages.

*These new methods were presented at the Chicago meeting of the Acoustical Society of America, October 23, 1951. A resume was published in the January, 1952, issue of the Journal of the Acoustical Society of America, Vol. 24, No. 1, page 87. The main parts of this dissertation have been accepted for publication in the March, 1952, issue of this Journal.

**Nomenclature proposed by P. J. Ernst in The Journal of the Acoustical Society of America, Vol. 23, No. 1, 80, January, 1951, as follows: "The production of a visible image by means of ultrasonics should be named ultrasonoscopy, that of a recorded one ultrasonography."

1/f NOISE

(L. C. Card No. Mic 60-2610)

Alfred Urquhart Mac Rae, Ph.D.
Syracuse University, 1960

A study of the 1/f noise in thin single crystal filaments of germanium has revealed that the noise is dependent on the surface properties of the material.

If the height of the inversion layer potential is increased by the application of a D.C. electric field applied perpendicular to the surface, the 1/f noise increases exponentially with the induced surface charge. No change in the 1/f noise occurs when the surface potential is varied if an inversion layer is present on the surface. Since no excess 1/f noise is obtained when a D.C. field is applied perpendicular to the accumulation layer surface, it was concluded that charge transfer between the slow surface states and the bulk is not an important 1/f noise producing mechanism.

When an electric field is applied perpendicular to the surface, the surface conductivity changes and then relaxes

back to its original value. The relaxation rate depends on the temperature, the surface treatment and the gases surrounding the crystal. It assumes a time dependence which is either exponential, logarithmic, or a combination of these two processes. The $1/f$ noise also relaxes back to its original value after its initial change by the electric field applied to the surface. This relaxation rate is dependent on the temperature and ambient, but the mode of the decay is always logarithmic, independent of the mode of the conductivity relaxation. Such a logarithmic relaxation can be expressed as the sum of many independent exponential relaxation processes if there is a distribution in the relaxation times which is proportional to the relaxation time associated with each state. It is precisely this $1/\tau$ distribution which has been proposed to account for the unique frequency spectrum of the $1/f$ noise.

While the $1/f$ noise associated with an accumulation layer is relatively temperature independent, the opposite is true for the $1/f$ noise associated with the inversion layer. In this instance the $1/f$ noise increases rapidly as the temperature is decreased from room temperature to 195°K for both n- and p-type bulk material.

The $1/f$ noise can be changed independently of any variation in the surface potential. It was observed that the $1/f$ noise decreases when the slow surface state relaxation time is increased. This increase in the slow state relaxation time is related to a corresponding decrease in the slow surface state density.

When a thin aluminum film was evaporated onto the surface, the $1/f$ noise increased. This film was in the form of $\sim 2 \times 10^4$ patches per cm^2 . These localized regions of high surface charge density caused $1/f$ noise voltage increases of two orders of magnitude for most of the samples. A similar film of the dielectric SiO_2 produced no change in the noise.

The results of this investigation indicate that the inhomogeneous potential barriers which exist near the surface and at contacts are the source of the $1/f$ noise. These surface inhomogeneities may arise from the dangling surface bonds or surface contamination due to adsorbed gases or impurities such as the previously mentioned aluminum film. Microfilm \$2.50; Xerox \$5.00. 96 pages.

PHYSIOLOGY

AN ELECTROMYOGRAPHIC STUDY OF THE EFFECT OF NEUROPHYSIOLOGICAL STIMULATION ON THE ANTAGONISTIC MUSCLES RELATIONSHIP IN CEREBRAL PALSY SPASTICITY

(L. C. Card No. Mic 60-2500)

M. Sami El-Beheri, H.S.D.
Indiana University, 1960

The Problem. The problem was to evaluate the effect of neurophysiological stimulation on the action potential relationship of two antagonistic muscles, the biceps brachii and the triceps brachii, in spastic cerebral palsy.

Procedures. Seventeen spastic cerebral palsy hemiplegics were used in this study. The subjects were divided at random to an experimental group of nine subjects to whom the treatment was administered for six weeks on a biweekly basis, and a control group of eight subjects who received no treatment of any kind during the experimental period. The treatment utilized the brushing technic for the involved triceps brachii.

Each subject was called for the electromyographic test three times. Unilateral and bilateral recordings were obtained by means of a four-channel Grass Model 5 A Polygraph and the action potentials were picked up by means of surface electrodes. The recordings were obtained with the subject in a supine position and while the supinated forearm was in nine different positions and motions.

Analysis of the data was accomplished by using the related groups method and the unrelated groups method to investigate the following sub-problems: (1) the action potential differences between the spastic and normal antagonists, (2) effect of the treatment on the ipsilateral side, and (3) transfer effect of the treatment on the contralateral side.

To investigate the action potential differences between

the spastic and normal antagonists, the t test of the significance of difference between means was applied to the initial measures of the spastic versus the normal muscles. Evaluation of the effect and the transfer effect of the treatment after two weeks and after six weeks was accomplished by applying the t test, then the F test, to the intermediate and final measures of the experimental versus the control subjects. The level of significance for the study was established at 5 per cent.

Conclusions. The most important conclusions are as follows:

1. During active flexion of the elbow, the action potential value of the spastic triceps seems to be greater than that of the normal triceps.
2. During active and resistive extensions of the elbow, the action potential values of the spastic biceps appear to be much greater than those of the normal biceps. After six weeks of treatment, there appears to be a noticeable decrease in the magnitude of the action potentials of the spastic muscle during both motions.
3. There appears to be no transfer effect of the treatment on the contralateral side.

Recommendations. The most important recommendations are as follows:

1. There is a possibility of investigating the effect of other related technics, such as stimulating the chemoreceptors, positioning the head, and positioning the body. Other antagonists may be employed.
2. Another study might utilize the needle electrodes to obtain precise information regarding the activity of the individual motor unit in terms of the frequency, amplitude, and pattern of its action potential spikes.
3. It would be of interest to determine the relationship between the effect of this treatment and the pattern of the schedule in terms of spacing, duration, and frequency of the individual treatment periods.

4. A similar study might be considered to determine the degree and duration of the lasting effect of the treatment after it had been discontinued for a certain length of time.

5. Consideration may be given to determine the effect

of certain surgical procedures, such as muscle transplants, tenotomies, and neurectomies in cerebral palsy and other disabilities, by studying the electromyograms of the cases involved.

Microfilm \$3.15; Xerox \$14.20. 241 pages.

POLITICAL SCIENCE

POLITICAL SCIENCE, GENERAL

THE SOUTH GERMAN LÄNDERRAT:
THE ORIGINS OF POSTWAR GERMAN FEDERALISM.

(L. C. Card No. Mic 60-2553)

Robert William Miller, Ph.D.
University of Michigan, 1960

Following the occupation of Germany by Allied forces in May 1945, the territory of the former Reich was divided into four occupation zones and each of the occupying powers proceeded to establish a German civilian administrative apparatus to aid in the execution of governmental functions under the supervision of military government authorities. In the American zone, which comprised the Laender (states) of Bavaria, Hesse, Württemberg-Baden and later Bremen, U.S. Military Government was confronted with an immensely complex set of problems ranging from the urgent need to re-establish a system of food supply and reviving some degree of economic activity to the equally important task of re-creating the basic conditions for the setting up of an administrative machinery to carry into effect occupation policies. Responsible occupation authorities thought it advisable and necessary to revive political life in the American zone by means of authorizing political party activity at the earliest possible date. While renewed political activity was developing at the local and state (Land) levels, Military Government devoted equal attention to the rebuilding of local and state governments within the three (later four) Laender under American military control. In this respect, one of the most urgent necessities resulting from the resumption of governmental activity in the zone was to devise an effective and economical machinery for the coordination of administrative activity both in the legislative and functional fields.

Under the auspices of the three South German state governments (and Bremen), and with the full backing of U. S. Military Government, a Laenderrat (Council of States) was established at Stuttgart in the autumn of 1945 to coordinate governmental activity within the American zone. Established as an association of the several states of the U. S. Zone, the Laenderrat assumed a central role in the political and economic reconstruction of the area under American jurisdiction, and eventually extended its influence beyond the zonal borders. Enjoying the unrestrained support and confidence of the U. S. Military Governor, this unique experiment in administering a territory under military occupation soon developed into an institution which was to assume a crucial place in the rebirth of the West German Federal Republic.

From a small coordinating agency the Laenderrat developed rapidly into a full-fledged administrative apparatus with a number of subordinate agencies. Its functional tasks

extended to virtually every aspect of administrative activity in the zone. As the principal agent in the field of legal coordination, the Laenderrat achieved a high degree of zonal uniformity with respect to the drafting, administering, and application of the laws, and thus succeeded in laying firm foundations of legal continuity for the time when a new German state would come into existence.

It was of great significance that the objectives of American occupation policy could be carried out with the full cooperation of German governmental personnel in the Laenderrat. This joint American-German effort was almost wholly devoid of conflict and friction which may have otherwise arisen, had American military and civilian personnel attempted to maintain a rigid victor-vanquished relationship between themselves and the Germans. Instead, the Laenderrat's American counterpart, the Regional Government Coordinating Office (RGCO) confined itself largely to advisory and supervisory functions, while increasing political and administrative responsibilities were placed into German hands.

As a momentous factor in the entire political evolution of West Germany toward a federal state, the South German Council of States made its political contribution as an institution of democracy and as a motivating force in laying the groundwork for the British-American combined area (Bizonia) and, later, for the Federal Republic of Germany. Having the essential earmarks of a confederation, the Stuttgart Laenderrat became the progenitor of postwar German federalism, and its member states came to assume a highly important role in the drafting of the 1948 Basic Law.

Another aspect of the Laenderrat's impact upon the evolution of the West German state lies in the singularly important contribution which this agency made toward the establishment of the Bonn government. A considerable degree of continuity between Stuttgart and Bonn may be discovered from the roster of administrative and parliamentary personnel appearing at the highest levels of the executive and legislative branches of the Federal Government.

Three conclusions can be drawn from this study: 1) As a stabilizer and coordinator among the South German states, the Laenderrat represented an indispensable instrument in the economic and political reconstruction of the American zone and later of the combined (British-American) economic area. 2) By succeeding, initially, in preserving the identity of the South German states, the Laenderrat later produced a favorable climate for the incorporation of the federal concept in the West German Basic Law and thus helped to lay the foundations for a political structure organized along federal lines. 3) The Laenderrat paved the way for a re-orientation in German political thinking along democratic lines by providing a nucleus of democratically oriented political leaders.

Microfilm \$2.55; Xerox \$8.80. 194 pages.

POLITICAL SCIENCE, INTERNATIONAL
LAW AND RELATIONS

TURKEY AND THE WESTERN WORLD: 1939-1959.

(L. C. Card No. Mic 60-2596)

Türkkaya Ataöv, Ph.D.
Syracuse University, 1960

Turkey is a link between the East and the West and a point where diverse political and economic schools of thought face each other. Both by geography and aspirations she is a European country, constituting a portion of the Balkan and the Mediterranean areas. In recent history she achieved a political, social and cultural evolution with inspiration derived from the West.

Turkey closely cooperated with the West because she had seen in as early as 1939 that the Western world was steadily moving away from the old spirit of domination and imperialism, while she could not help but perceive the appearance on the scene of first Fascist and Nazi, and later, of Communist imperialism. Turkey recognized Fascist Italy and the Third Reich as growing and militant menaces with dreams touching Turkish frontiers. Turkey's alliance with England and France on October 19, 1939, determined her attitude throughout the Second World War. The Turkish declaration of war on the Axis enabled her to join the ranks of the United Nations.

Turkey's main post-war concern was possible Soviet aggression and Communist infiltration. Her geographical position enabling her to perceive clearly the danger, Turkey sought, and received, Western support. Beginning with 1947 Turkey came to believe that the complex structure of the whole Western defense system should aim at surrounding the Iron Curtain with a system of interlocking alliances so that a Communist act of aggression against any part of this system would align such a combined power that would make the aggressor falter. Turkey believes that her active membership in NATO, the Council of Europe, the OEEC, the Balkan Pact and the Baghdad Pact contributes to this purpose.

Microfilm \$6.55; Xerox \$23.20. 515 pages.

GREAT POWER RELATIONS IN THE ORIGIN
AND DEVELOPMENT OF THE KINGDOM OF LIBYA

(L. C. Card No. Mic 60-2530)

Milton Feder, Ph.D.
University of Michigan, 1960

This study deals with the international politics of early Libyan statehood. It is primarily concerned with the policies of the United States, Great Britain, France, and the Soviet Union with respect to Libya before that territory became a state in 1951 and, to a lesser extent, with their policies since that time. This study attempts to show how the divergent policies of the Great Powers both complicated the settlement of a territorial problem and impeded the United Nations General Assembly to which the problem was eventually referred. The Assembly appears as an arena for the expression of the Great Powers' policies and also as an international body with its own functions

and responsibilities. The policies of the smaller members of the Assembly, especially those of the Arab and Latin American states, are also examined because these states influenced the decision.

The General Assembly appears to have had little choice but to grant Libya statehood. The desire to reach an early decision, the pressures of a heavy agenda, and the need for compromise between the Soviet and Western blocs on the one hand and between the colonial and anti-colonial groups on the other, seem to have impelled the Assembly to disregard Libya's need for trusteeship and to grant her statehood.

This study finds that the Assembly's decision satisfied the immediate interests of Great Britain and the United States. Great Britain wished to secure bases in Cyrenaica to shore up her Mediterranean holdings. The United States abandoned her early proposal for international supervision of Libya after she realized the advantage of maintaining air bases there. Today Great Britain and the United States have sizeable military installations in Libya. British and American grants all but maintain the new state.

French and Soviet interests appear to have been thwarted. France's difficulties with the nationalist movements in her North African territories damaged her relations with Libya. The Libyan government refused to permit France to retain bases in the Fezzan, and in 1957 France removed her troops. The Assembly's decision foreshadowed France's eviction from Libya. The Soviet Union sought to gain influence in Libya but was excluded by the Assembly's decision. Although the Soviet Union and Libya established diplomatic relations in 1955, Libya has continued her pro-Western orientation.

On the whole the Assembly's decision favored Arab interests in Libya. The Arab states pressed for the early creation of a Libyan state, and the Assembly's decision gratified this wish. However, the Arabs had also hoped to replace Great Britain and the United States as the mentors of the new state. In this respect Arab wishes were only partially realized. Libya emerged as a federal monarchy with a pro-Western king. The Arabs would have preferred that Libya have a unitary form of government and that she follow a neutralist foreign policy.

The Latin American states acted as a bloc in the Assembly and supported Italian claims to trusteeship. Although they failed to achieve their primary aim--the designation of Italy as trustee over Tripolitania--the Latin Americans won their demand that the decisions on Libya be linked with one that gave Italy trusteeship over Somaliland. The Latin Americans' position with respect to the Italian colonies contradicted their traditional policies of anti-colonialism and self-determination.

The study is based on an interpretation of published official documents and secondary sources. For the most part it proceeds chronologically. The policies of the Great Powers are described in the meetings of the Paris Peace Conference of 1946, the General Assembly in 1949, and during the transitional period from 1949 to 1951. From 1951 to 1958 Great Power interests are discussed as they are reflected in Libya's foreign relations.

Microfilm \$3.80; Xerox \$13.30. 295 pages.

POLITICAL SCIENCE, PUBLIC
ADMINISTRATIONUNITED NATIONS TECHNICAL ASSISTANCE
IN PUBLIC ADMINISTRATION WITH SPECIAL
REFERENCE TO THE PROVISION OF
OPERATIONAL AND EXECUTIVE PERSONNEL

(L. C. Card No. Mic 60-2613)

Faqr Muhammad, D.P.A.
Syracuse University, 1960

Political instability and administrative inadequacies prevailing in under-developed areas of the world are seriously hindering their economic and social development. The United Nations has been rendering technical assistance to these areas for more than ten years to help them build up their administrative resources. Such assistance has been in the form of administrative surveys, advisory missions, training projects in public administration, fellowships, and research and documentation. Recently the Organization has decided to provide operational and executive personnel to countries requesting such assistance.

At the beginning public administration was considered too sensitive a topic for outside experts and the program emphasis was on training. While this emphasis continues, more and more countries are coming forward to request advisory experts and officers to perform operational and executive functions.

The success of public administration programs is intimately influenced by political conditions prevailing in these areas. The United Nations cannot allow too much for politics and tends to emphasize techniques which cannot flourish in an adverse political climate. This remains a basic dilemma for the Organization.

Administrative changes are taking place in under-developed countries through all kinds of technical assistance programs of which the UN program of public administration is only one element. The realities of international organization -- proliferation of agencies, functional approach, different patterns of decentralization, etc. -- have, however, made the task of coordination of various elements of change rather difficult. These programs consequently run parallel, or even counter, to each other. The UN is treating public administration as one sector of technical assistance, whereas in fact it pervades all sectors.

On the whole the UN program is more in the nature of an offering rather than a response to a systematically determined demand from governments. All the same the policy of the United Nations to emphasize building of institutions which may become national sources of "technical assistance" for administrative improvement may have beneficial cumulative effect.

As to the provision of Operational and Executive Personnel, it is too early to draw conclusions. The scheme has, however, been hedged with too many restrictions to evolve smoothly into an international administrative service.

The present study records the evolution of the UN program in public administration up to the end of September 1959. It also analyzes the instruments of implementation developed by the UN for carrying out the program and its operational problems.

The study is based on intensive analysis of relevant UN papers and the writer's personal observance of the program in operation through his association with the UN Office of Public Administration for more than seven months under a special arrangement worked out by the Maxwell Graduate School of Syracuse University with that Office.

Microfilm \$4.70; Xerox \$16.65. 367 pages.

PSYCHOLOGY

PSYCHOLOGY, GENERAL

THE UPTAKE OF SODIUM IONS
BY THE TONGUE

(L. C. Card No. Mic 60-2495)

Magill Echols, Ph.D.
The University of Tennessee, 1960

Major Professor: Ernest Furchtgott

A search was made for evidence of some physiological change on or about the tongue which might be associated with the behavioral changes which occur during sodium deprivation. Sodium chloride, labelled with Na^{24} , a gamma emitter, was placed on the tongues of four rabbits which had experienced varying periods of sodium deprivation. Eight minutes after the application of the radioactive tracer, blood was drawn from the femoral veins of the animals and measurements for radioactivity of the blood were made. The degree of radioactivity was found to be

greater in the blood of the animals which had experienced longer periods of sodium deprivation.

Concurrently (one hour after the blood extractions) the animals were given access to a relatively strong (two per cent) solution of ordinary sodium chloride. The animals which had experienced the longer periods of sodium deprivation were those which drank the larger quantities of saline. This trend persisted even when the animals had access to both saline solution and distilled water.

In a separate study it was found that the serum sodium level in seven rabbits did not change significantly following periods of sodium deprivation of the longest duration used in the previous portions of this study.

The findings indicate that some process on or about the tongue is altered during sodium deprivation and that the drinking of saline concurrently is altered.

These data are compatible with many other experimental data in studies of preference behavior and may be of use in dealing with some apparent contradictions in previous findings.

Microfilm \$2.50; Xerox \$3.00. 40 pages.

THE REVISION AND VALIDATION OF THE HOW SUPERVISE? TEST - 1960.

(L. C. Card No. Mic 60-2237)

Ned Arnold Rosen, Ph.D.
Purdue University, 1960

Major Professor: Dr. H. H. Remmers

The objective of this research was to revise the How Supervise? Test, originally published in 1943, and to validate the revised form. The research hypothesis was that there is a general "human relations" role variable that cuts across organization lines and that is measured by this instrument.

Approximately 500 first-line supervisors and 100 middle-management personnel from 13 organizations of various types were included in the study. The experimental instrument included 267 items which were judged by "experts." Criterion data in the form of rank orders were used for concurrent validity analyses of several scoring keys. Internal consistency and inter-organization analyses were also conducted.

Although none of the scoring keys were characterized by a significant amount of concurrent validity upon cross-validation, the research hypothesis was supported by other aspects of the data.

Microfilm \$2.50; Xerox \$5.40. 108 pages.

APPLICATION OF THE THEORY OF SIGNAL DETECTABILITY TO AMPLITUDE DISCRIMINATION

(L. C. Card No. Mic 60-2577)

Wilson Pennell Tanner, Jr., Ph.D.
University of Michigan, 1960

This thesis investigated the relation between physical parameters and response behavior in two types of amplitude discrimination experiments. In the first, the signals were segments of pure tones of the same frequency and phase, differing only in amplitude. In the second, the signals were samples of noise from the same source, differing only in power.

First the experiments were analyzed within the framework of the theory of signal detectability. The relevant physical variables in an ideal experiment of the first type are the energy of the difference signal E_{Δ} and the noise power per cycle, N_o . In the second type, assuming both signals series band-limited in the same way, the relevant physical parameters are the power in the two signals, the bandwidth W and the duration T .

The relevant noise consisted of several components: that introduced by the experimenter N_G , the residual equipment noise N_E , and the cycle-to-cycle frequency and amplitude variations in the signal generator. Assumed proportional to the power output of the oscillator, this was designated kV_o^2 .

Experiments employing three observers were conducted investigating a limited set of conditions. Based on the theoretical study and experimental data, the following equation was developed to describe performance in the first type of experiment:

$$(d')^2 = \eta \frac{2E_{\Delta}}{N_G + 4 \times 10^{-12} + 4 \times 10^{-4} V_o^2}$$

where d' is a measure of performance. η is the efficiency of the observer, and N_E (4×10^{-12}) and k (4×10^{-4}) are constants which characterize the laboratory. In so far as it was possible to fit each observer's data with a single value of η , and all three observers with a single value of k it can be concluded that the observer's efficiency did not decrease with increasing values of V_o^2 .

For the equation to achieve generality a wider set of conditions must be investigated experimentally. The equation serves as a nucleus for the development of a more general equation incorporating additional variables such as signal duration and frequency and the observer's memory.

Since in the noise case measurements would be expected to include factors N_E and k , the following equation is shown to describe the data.

$$d' = \eta \sqrt{WT} \frac{S_o}{N_o} \sqrt{\frac{1}{\frac{1}{2} \left(\frac{S_o}{N_o} \right)^2 + \frac{S_o}{N_o} + 1}}$$

where η is the observer's efficiency relative to an ideal observer for noise signals, N_o is the noise power per cycle of the lower signal, and S_o is the noise power per cycle of the increment. In this case, however, η seems to decrease slightly as N_o increases.

The two equations supply a logically consistent explanation for the application of Weber's law to amplitude discrimination both for the cases of auditory signals which are segments of sine waves and auditory signals which are samples of noise.

Microfilm \$2.50; Xerox \$3.00. 55 pages.

A VALIDATION STUDY OF THE BLACKY ANALOGIES TEST

(L. C. Card No. Mic 60-2582)

Ann Louise Workman Vroom, Ph.D.
University of Michigan, 1960

The purpose of this study is to determine some aspects of the construct and predictive validity of the Blacky Analogies Test (BAT). This is an analogies test which uses Blacky pictures instead of words as solutions. It was hypothesized that these pictures would arouse anxiety which would tend to affect test performance. The latter is conceived as the resultant of interaction between intellectual ability, anxiety, and defense.

To determine the construct validity of the BAT, a battery of tests including the BAT, intellectual measures, and an anxiety measure was administered to 187 female and 114 male freshmen at the University of Michigan. Factor analyses of the BAT items and of the test battery were carried out. BAT scores were also related to measures of high school performance and to grade-point average at the end of the freshmen year.

The results of the investigation were as follows:

1. Factor analysis of the BAT items for the male sample revealed only one clear factor, identified as Letter Manipulation. This factor was not fully replicated in the female sample, so there was no basis for scoring items on the test separately.
2. Eight orthogonal factors were extracted from the test battery intercorrelations. Four of these factors had several different tests loading on them and were interpreted as Verbal Comprehension, Preparatory Reasoning, Verbal Flexibility, and Education of Conceptual Relationships. The remaining four factors were formed primarily by two parts of the same test. The latter were identified as Ideational Fluency, IPAT Anxiety, Adaptive Flexibility, and Logical Evaluation.
3. The BAT loaded most highly on Verbal Comprehension and Verbal Flexibility for the male sample and on Verbal Flexibility for the female sample. Lesser loadings on other intellectual factors were also noted.
4. It was found that the entire common variance of the BAT was nearly equal to its reliable variance. As the common variance could be accounted for solely by intellectual factors, it was concluded that there was no evidence to support the hypothesis that anxiety appreciably affects performance on the BAT.
5. The correlation between BAT and GPA was .45 ($N = 100$) and .34 ($N = 171$) for the male and female samples respectively.
6. The BAT was found to be a better predictor of grade-point average than high school percentile rank for the female sample, and to improve the prediction of grade-point average of men when included in a multiple correlation with high school percentile rank.
7. Prediction of grades from the BAT fell roughly in the same range as predictions from subtests of the American Council on Education Psychological Examination and the American Council on Education Cooperative English Test, C₂: Reading Comprehension. Multiple correlations show the BAT and these other tests to be approximately interchangeable in their predictive efficiency.

Microfilm \$2.50; Xerox \$6.60. 137 pages.

A PROBABILISTIC THEORY OF PREFERENTIAL CHOICE

(L. C. Card No. Mic 60-2592)

Joseph Louis Zinnes, Ph.D.
University of Michigan, 1960

Unlike most theories of preferential choice, in the Coombs Quadrant I (or Q) theory the stimuli can be scaled either in terms of their preferability or in terms of their discriminability. However, the Q theory has two severe limitations. It is difficult or impossible to obtain a solution if there is inconsistency or error in the data and at best it can only yield a relatively low level of measurement. This study developed and tested a probabilistic Q theory designed to overcome these two difficulties.

In the first part of the study, the equations for the probabilistic theory were developed and an approximate method of solution was indicated. This approximate method estimates the parameters of the theory from the

preference probabilities based on judgments satisfying certain conditions. In general, not all of the judgments in a given set of data would satisfy these conditions, so that only part of the data would be used in arriving at a solution. To test the adequacy of the theory in predicting the preference probabilities based on all judgments present in a given set of data, numerical methods for evaluating the integrals appearing in the equations of the Q theory were described.

The transitivity implications of the probabilistic Q theory were also discussed. It was shown that the Q theory does not necessarily imply strong stochastic transitivity (SST), which is in contrast with the Thurstone and Bradley-Luce theories, both of which imply SST.

In the experimental part of the study, subjects were required to indicate their preferences for Munsell colored chips presented pairwise. The ten stimuli ranged over two hues (red and blue-green) that formed a single dimension in the Munsell space. The data were analyzed by the probabilistic Q theory, the Thurstone theory and the Bradley-Luce theory.

The results indicated that for the stimuli employed in the experiment the Bradley-Luce and Thurstone theories were essentially equivalent. For a single hue, the Q theory was approximately equal to these theories, but when two hues were involved the Bradley-Luce and Thurstone theories better accounted for the data. However, in all cases when the parameters of the Bradley-Luce and Thurstone theories were evaluated from only part of the data, the Q theory better accounted for the entire data. There was some evidence that a two dimensional extension of the Q theory was required for two hues.

The results also had implications for the Munsell scale. When a single hue was involved, the Munsell scale represented, to a first approximation, a discrimination scale valid for both discriminative and preferential judgments. This, however, was not the case when more than one hue was involved.

One of the major factors limiting the degree to which the Q theory can reproduce data is the relatively small amount of data which can be incorporated into the method of solution. In particular, it was shown that the reproducibility of the Q theory was directly related to the amount of data used in the analysis.

Microfilm \$2.70; Xerox \$9.45. 208 pages.

PSYCHOLOGY, CLINICAL

THE EFFECTS OF INDUCED REGRESSION ON THINKING PROCESSES

(L. C. Card No. Mic 60-2503)

Phyllis Ackman, Ph.D.
University of Michigan, 1960

The aim of this study was to explore in normal individuals those aspects of thinking which are referred to in psychoanalytic literature as "primary process." The primary process utilizes the mechanisms of condensation, displacement, and symbolization, as for example, in

dreams; while secondary process thought operates by logic, syntax, and grammar.

The emergence of primary process aspects of thinking was experimentally facilitated by means of conditions of induced regression—hypnotic intervention and “fantastic” instructions for the Rorschach test. Eight subjects were used.

Two major hypotheses were formulated: primary process thinking would increase under hypnosis and under “fantastic” instructions.

The results only partially confirm these hypotheses. Using the Holt scoring system of primary process in the Rorschach, content and formal deviations were divided into Level I and Level II—a continuum representing the degree of socialization and acceptability of a response. Level I formal deviations, the more unsocialized deviations, appeared under hypnosis more frequently than under waking. Level II deviations, characterizing socialized responses, appear more often under waking.

Along with an increase in Level I formal deviations under hypnosis, the results confirm the prediction that attempts to control these deviations are less frequent than under the waking condition.

The results indicate, contrary to prediction, that content deviations, including aggression and libidinal references, do not increase under hypnosis, except for one sub-category in the total aggression index—Results of Aggression, and for Anxiety.

Standard scoring of Rorschach content and form-level categories did not show any significant change under hypnosis.

Hypothesis II predicted that an increase in primary process thinking would occur under “fantastic” instructions to regress. These instructions were designed to elicit a voluntarily controlled regression. Specifically, it was predicted that more drive-related content would be elicited by these instructions as compared to the standard instructions. This prediction is strongly confirmed by these data. It was also predicted that a greater need for control and defense would be required in order to render responses acceptable as socialized communication. This prediction was also confirmed. It was not expected that formal deviations would increase under the fantastic instructions. Contrary to this expectation, however, Level I deviations occurred more often than under standard instructions. Level II formal deviations did not tend to increase in this comparison.

It was anticipated that regression to primary process thinking predicted in Hypotheses I and II would be less possible when the stimuli were clearly structured. “Popular” represent responses that fall within this category. Results indicate that no differences in frequency of popular responses occur in the comparison of waking and hypnotic protocols.

Implications from three major findings in these data were drawn. The first of these is the Level I—Level II distinction. It would seem that two kinds of regression are represented by this distinction. Level II deviations may represent controlled regressions similar to the kind presumed to occur in the creative process. Their appearance in the waking protocols and their significant decrease in the hypnotic protocols led to the speculation that hypnosis interferes with “regression in the service of the ego.” A regression involving greater need to control and fewer attempts to control extreme Level I formal deviations is more characteristic of hypnosis.

One of the possible interpretations of the lack of change in standard scoring categories of the Rorschach is that these categories may represent the limits of change under hypnosis.

Speculations concerning the unexpected lack of increase in drive-centered aggression and libidinal responses under hypnosis included the nature of the sample and of the test itself, the dynamics of the hypnotic process, and general implications drawn from personality theory—that the ego functions that are given up under regression are the structural and formal ones rather than functions represented by content. Microfilm \$2.50; Xerox \$8.00. 174 pages.

A FACTOR AND ITEM ANALYSIS OF THE TEST OF G; CULTURE-FREE AND THE STANFORD-BINET, FORM L.

(L. C. Card No. Mic 60-2645)

Aline Halstead Kidd, Ph.D.
University of Arizona, 1960

Supervisor: Dorothy I. Marquart

The concept of culture-fair testing has developed out of research indicating that children from upper-middle and upper class Anglo homes score higher on intelligence tests than do children from other environments. The question remains of how much of this is due to differences in ability and how much is due to cultural weighting of the tests. Previous studies indicate that the Test of g: Culture-Free contains some culture fair elements. This study was undertaken to investigate the culture fair characteristics of the test, to determine which items are culture fair, to discover what aspects of intelligence are measured by the Test of g, and to determine implications for the testing of Mexican-American children.

Twenty-five Mexican-American and twenty-five Anglo children between the ages of 10-0 and 11-0 from the upper socio-economic level and twenty-five Mexican-American and twenty-five Anglo children within the same age range from the lower socio-economic level were selected on the basis of Warner's Index of Status Characteristics. Approximately one-half of each group was composed of males and the other half of females. Each child was given the Stanford-Binet, Form L, and the Test of g: Culture Free. One-half of the males and one-half of the females in each group took the Stanford-Binet first and the Test of g second. The order in which the tests were given was reversed for the remaining subjects.

For the entire sample in this investigation a mean intelligence quotient of 104.54 and a standard deviation of 18.48 were obtained from the Stanford-Binet. The mean intelligence quotient on the Test of g for these subjects is 93.88. The standard deviation is 19.85.

There is a positive relationship represented by a rho of .681 between scores obtained on the Binet and on the Test of g. Results from the two tests, therefore, may depend upon some of the same abilities.

The total sample was divided into two major groups. In Group A, items which did not differentiate between the Anglos and the Mexican-Americans at or beyond the ten per cent level when the Chi-square test was used were selected as culture fair for this group.

These items were then rechecked in Group B to determine whether they were culture fair when applied to a second group, and two items were eliminated as culturally weighted. All of the items on the Test of g were tested for the total sample, using the Chi-square test.

The twenty items selected as culture fair by this method are identical with those failing to differentiate between the ethnic groups in both Groups A and B.

Chi-squares were run for the same ethnic and socioeconomic status groups for the entire range of Binet items administered. Only three items on the Stanford-Binet, Paper Cutting at Years IX and XIII and Memory for Designs at Year IX, were found to be culture fair.

A factor analysis of the culture fair items from the Test of g indicates that these items measure four abilities: (a) ability to overcome inappropriate set; (b) ability to localize the elements of an item; (c) awareness of size concepts; and (d) ability to analyze a progressive series and to understand the essential shift in such a series.

The acculturation of the upper class Mexican-Americans has been shown to be, at the present time, such that upper class Mexican-American children can be tested adequately with tests standardized on Anglo children.

Mexican cultural patterns have been shown to persist among lower class Mexican-Americans. Acculturation, however, may be progressing. The persistence of such patterns and the low Binet intelligence quotients obtained by many of the children from this group indicate the necessity of using culture fair items to obtain an adequate measurement of the ability of such children.

Microfilm \$2.50; Xerox \$5.20. 101 pages.

THE REBIRTH FANTASY IN CATATONIC SCHIZOPHRENIA AND ITS IMPLICATIONS

(L. C. Card No. Mic 60-2635)

Martin Louis Krinsky, Ph.D.
The University of Oklahoma, 1960

Major Professor: Carl R. Oldroyd

The starting point was the clinical observation that catatonics frequently verbalize rebirth ideas. The literature also notes this fantasy in noncatatonic disorders and in normals. The problem involved the expression of the rebirth fantasy at levels other than direct verbalization. It was assumed that, if this fantasy were important for the individual, then it would be expressed in symbolic form on perceptual tests.

Forty catatonic schizophrenics made up the experimental group. Twenty psychiatric patients with a variety of diagnoses, along with 20 normals, formed the two control groups. Age limits were 18 to 42 and the groups were equated for age and education.

The Rorschach, a multiple choice Rorschach, and the recently devised Picture Series Test were used to determine the presence of rebirth ideation. All testing was administered individually in the sequence just described.

The rebirth criteria were established as the following Rorschach responses: larva, cocoon, tadpole, fetus, embryo, unborn animal, egg, seed, and caterpillar. These responses were assumed to represent the rebirth fantasy

in that they were regarded as possessing in common the attributes of a prebirth stage of biological development. The Rorschach was administered in the conventional manner. On the MCRT, three responses per card were given, one of which was a rebirth response as defined by the above criterion. The subjects were asked which of the three responses best fit each of the cards. The PST consisted of 10 cards, each showing 10 small pictures. One picture on each card depicted an example of the Rorschach rebirth criteria. The task was to indicate the pictures in the order in which they were seen. The score was the sequential position of the rebirth picture.

The Rorschach results showed that the catatonics significantly exceeded the controls in the number of subjects who gave rebirth responses. On the MCRT, the catatonics again exceeded the controls significantly. The PST showed no significant differences in the position of the rebirth pictures.

In a second experiment, the catatonics were subdivided on the basis of the presence or absence of Rorschach rebirth content. The hypothesis stated that the rebirth fantasy was a means of restitution for the catatonics, and its presence should therefore imply an attempt to recover from the psychosis. The subgroups were compared on the Rorschach location, determinant, and content categories. The results showed the "Present" group as having better surface controls, as being more realistic, somewhat more rigid, and less deteriorated. The hypothesis was therefore affirmatively supported, and the assumptions relative to rebirth and restitution seemed to be upheld.

It was concluded that catatonics are more strongly preoccupied with rebirth fantasies than noncatatonics. Among the catatonics, those who show Rorschach evidence of the rebirth fantasy seem to possess better retention on nonpsychotic personality features than the catatonics who do not show such evidence.

Microfilm \$2.50; Xerox \$4.60. 90 pages.

A STUDY OF FREE ASSOCIATION BASED ON COLLIER'S THEORY OF CONSCIOUSNESS AS A REGULATORY FIELD

(L. C. Card No. Mic 60-2636)

John R. Morris, Jr., Ph.D.
The University of Oklahoma, 1960

Major Professor: Professor William B. Lemmon

Collier's theory is an attempt to integrate much of the knowledge concerning conscious and unconscious processes into a systematic conceptual framework. The theory is concerned with the role of consciousness in the regulation of behavior. He has developed a series of dynamically related concepts dealing with the regulatory functions of the conscious field, which he applies to the study of psychopathology and psychotherapy.

On the basis of this theory, several predictions were made concerning the differential behavior of emotionally secure and insecure individuals on free association tasks. It was predicted that the secure individual would show greater verbal productivity than the insecure individual and that stress would have a greater effect on the insecure

individual than on the secure. It was also predicted that both secure and insecure individuals would react to stress by showing a decrease in verbal productivity.

Two groups of male subjects, one consisting of 21 secure individuals and the other of 21 insecure individuals, were selected from a group of 298 male college students enrolled in an introductory psychology course. The bases of selection were scores achieved on Maslow's Security-Insecurity Inventory and Harrower's Multiple Choice Rorschach Test. The groups were matched for verbal intellectual ability on the basis of the total score on the Ohio State Psychological Examination.

Two experimental tasks were utilized. The first consisted of a chain association test drawn from Jung's Word Association Test and composed of twenty stimulus words, ten non-stress words and ten stress words. As the subject was presented each word, he was allowed a 30 second association period, during which he was asked to verbalize all words that came to his mind and as many as he could within the 30-second period. The words were randomly presented. The second task consisted of a five-minute free association period, during which the subject was asked to talk about himself, saying anything and everything that came to his mind. This free association period was tape recorded and evaluated by three clinical judges using three nine-point scales, measuring spontaneity, defensiveness, and variability of content.

On the first task, the Secure Group produced significantly more associations than the Insecure Group, and both groups showed significantly fewer associations to the stress words than to the non-stress. However, both groups showed about the same amount of decrease to stress words. On the second task, mean judge's ratings showed that the secure individuals demonstrated greater spontaneity, less defensiveness, and greater variability of content. Intellectual ability was not a significant factor on either task.

The results were discussed with reference to Collier's theory and to the psychotherapeutic process.

Microfilm \$2.50; Xerox \$5.40. 109 pages.

SOME EGO SKILLS AND THEIR RELATION TO THE DIFFERENCES IN INTELLIGENCE BETWEEN THE MIDDLE AND LOWER CLASSES

(L. C. Card No. Mic 60-2557)

Jerree Louise Heeney Pawl, Ph.D.
University of Michigan, 1960

The basic assumption is that intelligence is closely related to the structure of the ego and its growth because of the dependence of the ability to manipulate symbols on basic ego skills that are based on the structure of the ego. An attempt has been made to relate this to the positive relationship of intelligence to social class.

A review of the literature on the differences in personality between the lower and middle classes suggested that the bulk of the differences could be conceptualized as a difference in the ability to control impulses, in favor of the middle class.

A review of the literature on social class and intelligence established the validity of the disparity and found

the explanations of it to center on either a strict hereditary basis or on the basis of the two classes having a differential familiarity with words. A number of studies suggested that the latter explanation could not possibly account for all of the differences.

The theory was suggested that the differences could in part be accounted for by the differential ego skills associated with the differential impulse control, as well as a difference in level of concept organization.

The development and elaboration of ego skills such as attending, maintaining a set, or, in psychoanalytic terms, the control of the distribution and organization of cathexes and counter-cathexes was analyzed in terms of the relationship to the amount of delay practiced. It was suggested that as the lower class could be seen as more impulsive, it was not unreasonable to assume that it practices less delay. Levels of concept organization were also discussed in terms of their relationship to delay, and an attempt was made to show why the lower class would have more affective, concrete, and functional levels of organization than abstract in comparison with the middle class.

Intelligence was defined for purposes of this thesis as the "manipulation of symbols." The dependence of the "manipulation of symbols" upon ego skills was outlined.

Social class was defined for the purposes of this thesis by father's occupation. The lower-class sample of thirty-nine came from a city of approximately 43,000 located in the middle of an urban, industrial center of approximately 3-1/2 million. The subjects were all male children (aged ten and eleven) of "blue-collar" fathers. The neighborhoods in which their schools were located suggested a very stable working population. The middle-class sample of forty ten- and eleven-year-old males was obtained from a Midwestern university town of approximately 50,000 inhabitants. A concerted effort was made to avoid too heavy a loading of the children of fathers on the faculty of the university.

In order to demonstrate the differential ego skills between the two classes, tests were chosen which were minimally verbal but which would presumably measure these ego skills. Verbal tests were included among the measures in the hope of demonstrating a hierarchical progression of discrimination between the classes and for purposes of examining the correlation of these verbal tests with the non-verbal ones.

The first two measures, intended to measure the ability to separate idea and affect, consisted of a modified form of the Rorschach and Reversible Figures. The next task, measuring the resistance to illusion, was Circle Size. Also included were the Gottschaldt Hidden Figures and Color Reading. Three of the tests were verbal in nature: the Three Word Game, Vocabulary, and Similarities.

All of these measures except the first two were predicted to discriminate between the two classes in favor of the middle class. In general, the predictions were borne out.

On the Similarities, which is scored 2 (correct and essentially abstract), 1 (correct and functional or concrete), and 0, it was predicted and confirmed that of those items correct, significantly more of the answers of the middle class would be 2-point answers than those of the lower class.

An intercorrelation matrix showed considerable correlation between the measures not only for the total group but also within the groups. A factor analysis of the results

gave a number of hints about the possible organization of the ego skills tapped in this study.

No results were opposite to prediction or appeared to contradict the theory.

The results as a whole lend considerable support to the theory that the ego structures of the middle and the lower class, as reflected in certain ego skills, play a significant role in the differences that exist between the classes in intelligence. Microfilm \$2.50; Xerox \$7.60. 164 pages.

AN EXPERIMENTAL INVESTIGATION OF THE
EFFECTS AND PERSISTENCE OF SET DIRECTED
TOWARD INCREASING RESPONSES ON THE
COLOR VARIABLES IN RORSCHACH

(L. C. Card No. Mic 60-2622)

Sidney M. Rappaport, Ph.D.
Temple University, 1954

The two main objectives of this investigation were:

(1) to determine the stability of the Rorschach color variable under two conditions of set, and (2) to determine the degree of persistence of the effects of each set.

This study differed from earlier reports on the modifiability of Rorschach test patterns of normal subjects under varied sets in that none of the previous studies attempted to compare the effects of a "direct" and "indirect" set on the same variable on a comparable experimental group. In addition, as contrasted with earlier studies our experimental design provided a more adequate check on the persistence of changes induced by set.

Sixty college freshman students between the ages of 17 - 19 participated in a series of three Rorschach tests. They were randomly assigned to three groups designated as Group A ("Controls"); Group B ("Verbal-Instruction Set"); and, Group C ("Task-Induced Set"). Each test was individually administered without testing-the-limits by the same examiner under trial conditions as set forth below:

Trial I - Standard procedure for all groups.

Trial II - Group A: Standard procedure.

Group B: "Verbal-Instruction Set" toward increasing color responses.

Group C: "Task-Induced Set" directed toward color.

Trial III - Re-test of all groups under "standard" procedure.

All records were scored by the Klopfer method without knowledge of the personal, group or trial identity of the subject. The following Rorschach variables were selected for detailed investigations: Sum C, FC, R and N.

On the basis of the analysis of 180 Rorschach records the following findings were reported:

1. Under conditions of set as defined by this study and generally described as "direct" ("Verbal-Instruction") and "indirect" ("Task-Induced"), there was a significant increase in color productivity as represented by variables Sum C and FC. The "color" variable was equally unstable under either type of experimental set.

2. Alterations in color score were of sufficient magnitude to alter the M:Sum C color ratio in the direction of color for 40% of Group B and 45% of Group C subjects.

3. Increases in color scores were largely form-color determined (FC).

4. Under experimental conditions, M was not significantly influenced when attention was focused on color.

5. The effects of set, as measured by re-test under standard procedure after an interval of four weeks, do not persist. Statistically significant increases in Sum C and FC scores attained under experimental conditions are not maintained. They returned to a point where no statistically significant difference existed between Trial III scores and levels previously established under Trial I.

As a supplement to the main study, a minor investigation was conducted to determine whether color productivity on the Rorschach is correlated with the kinds of traits measured by non-projective tests of the questionnaire type. For this purpose the Guilford-Zimmerman Temperament Survey was used. Our conclusions with respect to this portion of the study were:

1. Pearson correlations between Sum C scores and personality traits defined by the Guilford-Zimmerman as General Activity, Restraint, Ascendancy, Social Interest, Objectivity, Friendliness, Thoughtfulness, Personal Relations and Masculinity failed to show statistical significance, and

2. A very low but statistically significant negative correlation was found between Sum C and the Guilford-Zimmerman scale for Emotional Instability.

In conclusion, the findings of the major portion of this experiment corroborate other reports indicating that the Rorschach scores of normal, college level subjects can be modified by set induced by verbal instruction. Moreover, contrary to the findings of Norman, Liverant, and Redlo, it provided data indicating that "indirect" or "superficial" set induced by pre-test activity can also modify test performances. This, consequently, added further support to previous experimentation revealing the effects of transient testing conditions on Rorschach test responses.

Of particular significance were the findings of this investigation indicating that the effects of set did not persist and that Rorschach scores modified under conditions of experimental set returned, within limits of statistical comparability, to their original levels.

Microfilm \$2.50; Xerox \$5.00. 100 pages.

INVESTIGATION OF TWO ASPECTS OF
BONE CONDUCTION TESTING: PLACEMENT
OF THE VIBRATOR ON THE HEAD AND
PRESENTATION OF THE MASKING SOUND.

(L. C. Card No. Mic 60-2616)

Gerald Arthur Studebaker, Ph.D.
Syracuse University, 1960

The investigation was designed to evaluate and compare the forehead, the vertex, and the mastoid as positions for the placement of the bone conduction vibrator by finding which has (1) the lowest pure tone threshold, (2) the smallest intersubject and intrasubject variability, and (3) the greatest independence of threshold from pathological changes in the middle ear. A formula was devised to calculate the optimum masking intensity to ensure the proper masking of the opposite ear during the bone conduction measurements:

$$\text{Optimum Masking Intensity} = BC_t + \frac{AC_m - BC_m}{2} + Md.Pt.$$

where BC_t is the bone conduction loss of the tested ear;

$\frac{AC_m - BC_m}{2}$ is the difference between one half of the air

and bone conduction losses of the masked ear; and Md.Pt. is the midpoint between minimum and maximum masking for subjects with normal hearing. Minimum necessary masking was found for a broad band and a narrow band noise by measuring the intensity which is just sufficient to mask pure tones at threshold intensity. Maximum permissible masking was found by measuring the intensity of each noise that is just sufficient to mask the test tones in the contralateral ear.

The two noises were compared to learn which produces the greatest masking at equal loudness. It was found that the narrow band noise is a more efficient masker, producing from 21.0 db at 250 cps to 7.9 db at 4000 cps more masking than the broad band noise. A semi-insert earphone for masking stimuli was constructed to learn if it increased the maximum masking over that with a standard earphone. The maximum masking was 11 to 15 db higher when the noise was presented with the semi-insert earphone. Therefore, the narrow band noise and the semi-insert earphone were used for contralateral masking during the bone conduction measurements.

The thresholds measured at the forehead were approximately 9 to 16 db higher than those measured at the mastoid and from 9 db higher to 2 db lower than the thresholds at the vertex. The thresholds at the vertex were approximately 7 to 12 db higher than at the mastoid.

The intrasubject variability of the thresholds at the three positions was not statistically different, while the intersubject variability was significantly smaller at the forehead than at the mastoid. The intersubject variability of the vertex and the other two positions was not statistically different. With subjects with conductive hearing loss, the variability was greatest at the vertex and smallest at the forehead. The difference between the variability at the vertex and the other two positions was statistically significant while the difference between the mastoid and the forehead variability was not significant.

The hearing loss measured at the forehead was significantly smaller than at the mastoid. The hearing loss measured at the vertex was significantly larger than at the forehead at 250, 500, and 1000 cps and significantly smaller than at the mastoid at 2000 and 4000 cps.

Although its threshold is highest, the forehead offers the greatest independence from the middle ear condition. Also, the variability between subjects is smallest at the forehead position. It was concluded that the forehead is a better position from which to test the bone conduction threshold than the vertex or the mastoid.

Microfilm \$2.60; Xerox \$9.00. 198 pages.

PSYCHOLOGY, EXPERIMENTAL

SENSORY DEPRIVATION AND MAINTAINED SENSORY INPUT IN MONKEYS: A BEHAVIORAL AND NEUROPHARMACOLOGICAL STUDY.

(L. C. Card No. Mic 60-2531)

Stephen Sorin Fox, Ph.D.
University of Michigan, 1960

A series of experiments was designed to investigate behavior by which sensory input levels are maintained by monkeys' bar-pressing for light. The studies were planned with an aim toward clarifying the possible neural mechanisms associated with this behavior. More specifically, it was intended to examine the relationship between such maintained sensory input and (1) sensory deprivation, (2) level of ambient light, (3) amphetamine arousal, and (4) electrophysiological activity in the thalamic and brain stem reticular systems.

Experiment I. (N=8) Constant and regular rates of response were observed to occur during test periods when the response was bar-pressing for .5 sec. of light. Response rate increased quantitatively with increasing sensory deprivation. Analysis of variance for deprivation effects was significant at P less than .001.

Experiment II. (N=8) By partially compensating with various levels of ambient light during the test periods, response rates were decreased for all durations of deprivation. Analysis of variance shows a P value of less than .001 for both deprivation and ambient-light effects.

Experiment III. (N=8) Injected amphetamine clearly and markedly increased the response rate for light, as compared with the rate with drug and no light reward and with no drug and light reward alone. This was interpreted to mean that the drug increased the animal's requirements for sensory input.

Experiment IV. (N=6) The animals were chronically implanted with deep electrodes and allowed to bar-press for light. Recordings from these electrodes, taken in response-free periods during behavioral tests, showed regularly increasing percentages of slow activity of very high voltage which reach a maximum immediately preceding (approx. 20 sec.) a burst of behavioral responses. Chi square analysis showed that the increasing appearance of these "hyper-alpha" waves at this time was not due to chance (P less than .001). Percent of slow activity was analyzed for periods just preceding a response-burst, and was shown to be significantly present in high percentages. Slow activity at the midpoint between response-bursts was shown to be significantly low in percentage. Hyper-alpha activity was interpreted to be closely related to the occurrence of a burst of responses. Arbitrary and voluntary onset of light wash shown to be a factor in the amount of desynchrony that the light produces in the EEG record.

Discussion of the findings is in terms of a new two-factor theory, involving both chronic and acute activation levels in the diffusely projecting systems of the brain.

The position taken is that behavior which maintains sensory input operates to 'match' present levels of input with long-term or chronic activation levels. Need for sensory input comes about through a discrepancy between present input and the chronic activation level. Acute activation refers to the short-term, transient effects of input upon the nervous system.

Microfilm \$2.50; Xerox \$5.40. 109 pages.

REACTION TIME TO SEQUENTIAL
STIMULUS PRESENTATIONS

(L. C. Card No. Mic 60-2546)

Sylvan Kornblum, Ph.D.
University of Michigan, 1960

An attempt was made to separate decision time from response time in a choice reaction-time experiment. It was assumed that the processes whereby the stimuli are identified and whereby the appropriate responses are made are sequential. The experimental technique was designed to manipulate independently the uncertainty of the decision, the time allowed for it to be made, and the uncertainty of the response.

Eight white neon lights placed at the cardinal points on the periphery of a circle ($r = 1.5''$) constituted the stimulus presentation device. The responses were verbal and were recorded with a voice key to an accuracy of .001 seconds. Three subjects participated in the entire study.

A typical trial during the major experiments for this study consisted of the sequential presentation of two displays of lights. Each display was made up by turning on a subset of the eight stimulus lights. The second display differed from the first by only one light: either an additional light had been turned on, or one of the original lights had been turned off. The subject's task was to respond to that single light which had changed state in the second display. In order to identify that light correctly, therefore, the state of each light in the first display has to be known. Thus the uncertainty of the decision was manipulated by turning on permutations of a predetermined number of lights in the first display; the time allowed for the decision was controlled by varying the duration for which the first display lasted; and the uncertainty of the response was fixed by the number of lights which were relevant for a particular run.

Two hypotheses were formulated: (1) the reaction time to two sequential displays is an inverse function of the duration of the first display; and (2) given a range of uncertainties for the first display, the observed reaction time will be an increasing function of that uncertainty where the duration of the first display is short and constant.

In experiment I the stimuli were chosen equiprobably from among a set of alternatives ranging from one to eight.

During the first display all the relevant lights either went on or they stayed off. During the second display one light either went off or on. The two displays followed each other instantaneously. The reaction time in this experiment was found to be approximately linear with uncertainty. On the average the reaction time to a light going off was longer than to a light going on.

Experiments II and III constitute the main experiments of this study and differ in only one major respect. In experiment II the first and second displays followed each other instantaneously, while in experiment III they were separated by a .1-second interval during which all the lights were off. The number of relevant lights in these two experiments was restricted to four, five, and six lights. The particular number of relevant lights was constant for a run. In addition, the duration of the first display was fixed for a run at either 25, 50, 150, 300, or 500 milliseconds. The results were as follows:

1. In general, the reaction time in experiment III was longer than in experiment II.

2. The reaction time to a light going off was faster than to a light going on in experiment II; this finding was reversed in experiment III.

3. In experiment II, as the duration of the first display increased, the reaction time decreased at the short durations and increased at the long durations when a light went off; when a light went on the reaction time was constant. In experiment III the duration of the first display had no effect.

4. As the number of lights increased in the first display of experiment II, the reaction time increased to a light going off and decreased to a light going on. No such systematic effects were found in experiment III.

5. In a further experiment reaction time was found to increase by increasing the duration of the intervals between the two displays.

6. The decrease in reaction time as a result of practice was found to increase linearly with uncertainty.

These results indicate that the hypotheses were partially supported in only a few instances. The difficulties which were thus encountered more than ever indicate the necessity of controlling sensory effects and of separating the uncertainty in the stimuli from that of the response if statements about "decision time" are to have any foundation in data. Microfilm \$2.55; Xerox \$9.00. 196 pages.

SOCIAL PSYCHOLOGY

INTENTIONAL AND INCIDENTAL LEARNING AS
A FUNCTION OF SELECTION PROCESSES

(L. C. Card No. Mic 60-2512)

Eugene Burnstein, Ph.D.
University of Michigan, 1960

The purpose of these studies is to examine a complex discrimination and learning situation called selection learning. This paradigm has the following characteristics: Individuals are presented with a list of items to learn.

Interspersed among these items are a number of incidental items which are to be ignored. The intentional items are characterized by an attribute called the selection cue which permits them to be discriminated from the incidental items. Selection learning differs from ordinary rote learning in that the latter procedure does not utilize any incidental items. Only intentional items are presented.

In an exploratory experiment no differences in acquisition between selectors and rote learners were obtained. Yet after an hour, selectors retained more items than persons who had learned under the traditional rote procedure.

It was hypothesized that there exist two factors in selection learning which cancel each other in acquisition, thus preventing differences in performance from appearing. One factor, facilitation of learning, was hypothesized to be a direct function of the informativeness of the selection cue. The other, interference with recall of intentional items, was hypothesized to vary directly with the amount of learning of the incidental items. It was further hypothesized that the effects of interference dissipate more rapidly than the effects of facilitation. Two series of experiments were conducted to demonstrate the effects of both factors.

In experiment I the selection cue was systematically varied. Selectors with an informative cue utilized an attribute highly relevant to the identity of the item. Selectors with an uninformative cue utilized an attribute irrelevant to the identity of the item. No differences occurred in acquisition. But informative cue selectors were superior in retention. In experiment II the number of incidental items, and thereby the amount of interference, was reduced. It was found that under these conditions acquisition is enhanced and that selectors with informative cues manifest a higher level of acquisition than those with uninformative cues.

In one of the experiments dealing with the second factor, interference was demonstrated when short recall latencies were required. Under such conditions informative cue selectors, who it was hypothesized were confronted with the most interference, displayed the worst performance while ordinary rote learners demonstrated the best. In experiment IV incidental learning was examined. Since interference derives from competing associations established by incidental learning, the amount of incidental learning, and thereby the amount of interference, should be greatest under informative cue conditions. When measures of incidental learning were obtained, the hypothesis was confirmed.

The retention effects demonstrated in the exploratory experiment and in experiment I were shown to depend (1) on the presence of interference in acquisition; and (2) on the dissipation of interference during the interval between the last practice trial and the test of retention. Since informative cue selectors are confronted with more interference in acquisition, their performance benefits more from dissipation of interference than the other experimental groups, and therefore they manifest superior recall in a test of memory.

Microfilm \$2.50; Xerox \$4.20. 76 pages.

THE USE OF MULTIPLE OBJECTIVE
MEASURES IN SURVEY RESEARCH AS
A MEANS FOR PREDICTING RESPONDENT
FUTURE BEHAVIOR

(L. C. Card No. Mic 60-2484)

Peter Andrew Holman, Ph.D.
University of Southern California, 1960

Chairman: Professor Ruch

This study was designed to test the predictive validity of objective measures of attitude and personality when

used in combination as part of a public opinion of market research questionnaire. It was hypothesized that a predictor equation could be developed, on the basis of such multiple measures, which would possess high validity for predicting the future performance or nonperformance by survey respondents of the behavior which was the survey subject.

Questionnaires requesting statements of intention to attend or not to attend football games were administered to classes of college sophomores and were followed after a selected football game by a questionnaire requesting reports of attendance. A total of 307 questionnaires for which intention and report could be matched, using student signatures, were obtained. Each questionnaire also contained seven eight-item personality measures and one eight-item measure of attitude toward football.

The 307 questionnaires were randomly divided equally into a prediction sample and a validation sample. Discriminant function equations were computed on the basis of interrelationships between the measures and behavior of the prediction sample. These equations were used to predict the attendance and, separately, the intention statements of individuals in the validation sample by multiplying equation coefficients against scores on the measures for each individual in the validation sample.

Because of significant differences between biosocial groups (sex and fraternity vs. independent student) in football game attendance and on the measures, four discriminant functions were developed for attendance predictions, one for each biosocial group. Only one of these (for sorority women) had predictive value; this equation yielded 73 per cent correct predictions. Two discriminant functions were developed for prediction of student intention, one for men and one for women. These equations resulted in 62 per cent correct prediction of student intention (will attend or will not attend) for the criterion game. Chi-square tests indicated that these successes in prediction had a less than .01 chance probability.

An analysis of discrepancies between student statements of intention and actual behavior showed that individuals in the group who responded "not sure" when asked their intentions and then did not attend the criterion game were characterized by high scores on attitudinal and motivational factors favoring attendance at the game and by low scores on measures of realistic thinking and orderliness. The "not sure" group constituted a third of the sample; of these, 60 per cent did not attend the criterion game.

Conclusions. 1. Total sample statements of intention to attend were 73 per cent accurate as predictors of behavior; when the sample was fractionated in terms of biosocial group and direction of prediction, subsample intention statements were from 60 to 96 per cent accurate.

2. Objective measures of attitude and personality, obtained under public-opinion-survey conditions and weighted for importance by a rigorously objective technique, have been shown to possess validity, where validity is defined as predicting behavior in a real-life environment.

3. The importance of given attitudes and personality characteristics as determiners of behavior varied from subgroup to subgroup in the population.

4. Measures of attitude and personality were found to be more highly correlated with statements of intention than with actual subsequent behavior.

5. Failure of respondents to perform a desired behavior,

as indicated by a "not sure" response coupled with high scores on measures generally motivating toward such behavior, was highly correlated with low scores on measures of realistic thinking and orderliness.

6. A substantial contributor to the poor correlation between attitude and behavior as compared with the relatively high correlation between attitude and intention was the behavior of the "not sure" group.

Microfilm \$2.50; Xerox \$5.80. 117 pages.

SOME FACTORS AFFECTING THE ACCURACY OF UPWARD COMMUNICATION AT MIDDLE MANAGEMENT LEVELS IN INDUSTRIAL ORGANIZATIONS

(L. C. Card No. Mic 60-2559)

William Herbert Read, Ph.D.
University of Michigan, 1960

This study is concerned with upward communication in industrial organizations. Its purpose is to test hypotheses about the relationship between upward mobility drive among executives and the accuracy with which they communicate problem-related information to their immediate superiors. The hypotheses state that this relationship is in the negative direction, and that it is conditioned by a) the subordinate's trust in his superior's motives and intentions, b) the subordinate's perception of the degree of his superior's influence, c) the joint effects of trust and perceived influence, and d) the relative importance the subordinate attaches to his work problems.

Data were obtained from 52 pairs of superior-subordinate executives at the middle levels of three industrial organizations. An index of agreement between the subordinate and his superior about the relative difficulty of the subordinate's work problems was used as the measure of accuracy of upward communication. Three measures of upward mobility drive were used: 1) strength of mobility need, 2) degree of previous worklife mobility, and 3) degree of intergenerational mobility. Short questionnaires were used to measure trust and perceived influence. The types of problems the subordinate named as most important, and as least important to his advancement were used as indices of problem importance.

The results generally substantiated the predicted negative relationship between upward mobility drive and accuracy of upward communication, and this relationship was found to hold irrespective of the perceived relative importance of these problems to the subordinate's advancement. Both the need and worklife aspects of upward mobility drive were related to the accuracy with which executives communicated the problems they reported encountering in their work, while the intergenerational aspect of upward mobility was not significantly related to communication accuracy. Thus both present need, as well as the prior success of the subordinate executive in advancing from his first to his present job, are mobility factors which affect the freedom or restraint with which he communicates.

The negative relationships for both need and worklife mobility were greater in instances in which the subordinate did not fully trust his superior's motives and intentions.

Hence, inaccurate communication between middle-management levels is maximized when the subordinate perceives his superior to be non-supportive. There was also some suggestive evidence to show that communication of problems was less free from subordinates who considered superiors to have a high degree of influence or control over their careers, than from subordinates who perceived their superiors to have relatively low influence.

This study shows that upward mobility drive is one factor which affects the distortion of information passed upward in an industrial hierarchy. The more upwardly mobile the executive, the greater is the tendency to withhold or distort information potentially threatening to his career progress. This tendency is modified by the executive's trust in his superior, but the results in general suggest that to the degree to which organizations emphasize promotion as the primary incentive for their members, they may introduce obstacles to the effective functioning of both individual superior-subordinate relationships and the organizations as a whole.

Microfilm \$2.50; Xerox \$4.60. 88 pages.

SOME FACTORS ASSOCIATED WITH INTERNALIZATION OF MOTIVATION TOWARDS OCCUPATIONAL ROLE PERFORMANCE

(L. C. Card No. Mic 60-2567)

Carol Winifred Rosenfield Slater, Ph.D.
University of Michigan, 1960

An attempt was made to identify factors associated with the moderate internalization of occupational role requirements--i.e., with the persistence of motivation towards task performance in the absence of concrete situational support. A random sample, stratified with respect to occupational category (trade) and wage level was selected from non-supervisory blue collar workers at a large oil refinery in Ontario. Four hundred eighty-nine men both took part in a personal interview and completed pencil and paper questionnaires. In addition, judgments about various characteristics of their occupational roles were gathered independently from supervisory personnel.

Three measures of internalization were considered and their validity is discussed in some detail. It is suggested that the likelihood of perseveration--continuing to think about unsettled job problems after work--meets the conceptual and empirical requirements of the problem as outlined. Attitude towards reading work-related material as a leisure activity and likelihood of being bothered after a bad day at work are given attention as alternate operationalizations.

Data are presented to support the hypothesis that internalization of occupational role requirements is more likely when their fulfillment is potentially instrumental to the maintenance of the self-identity system of the individual than when it is not. Thus, internalization appears to be associated with the existence of situations which combine important social relationships with relatively high salience of an occupational frame of reference--situations where dimensions of self-characterization relevant to role performance are also relevant to interaction with significant others. Both talking with friends and with family about

things that happen on the job and friendliness with co-workers are associated with internalization.

Similarly, internalization also appears to be associated with other factors which would be expected to increase the identity-relevance of role performance. Evidence is presented consistent with the hypothesis that internalization is more likely when the self-characterizations involved in role performance

(1) facilitate the cognitive structuring of significant social situations and,

(2) are likely to lead to positive rather than negative self-evaluation.

Among the concrete characteristics associated with internalization were self-determination of behavior within the role, belief by supervisors that the job required a relatively high degree of aptitude, favorable evaluations by others familiar with the job, the chance it allowed to talk with workmates and its functional significance within the refinery.

Among the factors showing no direct association with internalization were degree of problem solving required (as rated by supervisors), their rating of the amount of time required to learn the job, past or present employment of relatives at the refinery and place of childhood.

Microfilm \$2.90; Xerox \$10.15. 224 pages.

SOCIOLOGY

SOCIOLOGY, GENERAL

SOCIAL WORK AND SOCIAL SCIENCE: AN ANALYSIS OF THEIR RELATIONSHIP.

(L. C. Card No. Mic 60-2532)

David Garfield French, Ph.D.
University of Michigan, 1960

The problem addressed in this dissertation is the utilization of social science theory and research in social work. Two general factors affecting the application of social science in social work are recognized: the adequacy of the theoretical and methodological tools of social science for dealing with problems arising in social work; and the adequacy of the institutional arrangements through which social science oriented research effort is carried forward in social work.

The procedure followed has been to present a theoretical framework for viewing the problems of relationship between social work and social science, and to use this framework for diagnosing problems of relationship and developing a series of propositions about them. The theoretical framework used is that of social system theory as expounded by Talcott Parsons. Social work and social science are described as social subsystems, and two concepts in social system theory considered in some detail, the concepts of value orientations and allocative processes. Points of difference between social work and social science are identified and their implications pointed out for utilization of social science in social work.

The categories and processes of social system theory are used to phrase a series of twenty-nine propositions about the utilization of social science in social work. The propositions are presented as hypotheses to guide research on the relationship of social science and social work, and as recommendations for administrative arrangements and policies for the use of social scientists in social work.

The propositions are drawn for the most part from the observations and experiences of the author in the program of advanced training and research in social work and social science at the University of Michigan. Among the major propositions presented are: The contribution of

social science to social work requires the institutional supports represented by the University. Research activity focused on general extension of knowledge in social work calls for an organizational pattern which gives maximum protection to the autonomy of the individual investigator; that focused on problem solving for particular social work agencies calls for a pattern which permits mobilization of technical skills around limited objectives. Resolution of differences between professional and scientific norms and objectives must be achieved by appeal to a more inclusive value system than that of either science or practice. Sustained and cumulative development of the contribution of social science to social work requires the development of organizational structures and role supports designed specifically for this task.

The concluding chapter is devoted to an evaluation of the usefulness of social system theory for the task undertaken in the dissertation. Three major criticisms that have been advanced are summarized and discussed. In addition, two proposed research projects employing social system theory are outlined, one on the utilization of applied social science in welfare planning councils, the other on the training of persons for the role of applied social scientist in social work. The conclusion is reached that social system theory provides practical assistance in planning and carrying out research on social science utilization in social work. Microfilm \$2.50; Xerox \$8.00. 175 pages.

THE CAREER BUSINESS EXECUTIVE AS A DEFINITIVE OCCUPATIONAL TYPE

(L. C. Card No. Mic 60-2485)

Harold Gene Hubbard, Ph.D.
University of Southern California, 1960

Chairman: Professor McDonagh

The central purpose of this investigation was to study six dimensions of career development within a framework provided by a theoretical model. These dimensions

included career goals, personal values, career satisfaction, recruitment patterns, generational mobility, and career mobility. The theoretical model postulated a continuum of occupational determinateness along which behaviors are ranged according to their degree of explicitness and rigidity. It was hypothesized that business executives represented an indeterminate occupational type and that there were intraoccupational variations within the occupation of business executives.

One hundred and two executives from the vice-presidential level of management were selected from Poor's Register of Directors and Executives, 1959. Executives were drawn from companies engaged in manufacturing and having an annual sales volume between 25 and 50 million dollars. They were grouped into three categories to afford the opportunity to make intraoccupational comparisons: (1) executives occupying technical positions, (2) executives handling auxiliary and staff functions, and (3) executives charged with a broad range of managerial responsibilities. An interview schedule was designed and a personal interview of one hour in length was conducted with each executive. Interview data were coded and punched on IBM cards and statistically analyzed by the IBM-709 electronic data-processing system at the Western Data Processing Center.

The principal findings were: (1) Executives manifested career goals which were economic in nature with regard to their present employment as well as jobs which they might hold in the future; insofar as past employment was concerned, opportunity for career development was the most important goal. (2) The basic values expressed by executives included a desire for security, coupled with adventure and leadership, and the desire to make money and gain personal recognition. (3) A high degree of career satisfaction was evidenced; executives would make the same

career choice again, encourage a son to enter business, rate their career as the most important source of satisfaction, rank their career second in the occupational hierarchy in contribution to society and equal to the professions in status and prestige. (4) The largest number of executives made the decision to enter business after completing their formal education; family, personal friends, and admired persons were the most important influence in the decision to enter business, and were the most important source of knowledge and insight regarding a career in business. (5) Executives experienced either horizontal or downward mobility at the time of entry into the labor force. (6) Executives experienced a minimum of career mobility; moves upward in management were few in number but were broad in range. (7) Technical, staff, and managerial vice-presidents differed significantly with reference to career goals; they differed in a less clear-cut manner with regard to personal values and decision age to enter business; there were no differences regarding job satisfaction, generational mobility, and career mobility.

Finally, it was concluded that business executives as a group did not consistently manifest behavioral characteristics which typified an indeterminate occupational type. Intraoccupational differences were manifest in certain behavioral characteristics, while in other behavioral characteristics, executives evinced no differences. The theoretical model of occupational determinateness is limited to illustrating relative intraoccupational variations rather than definitive positions occupied by occupational subgroups on the hypothetical continuum. The theoretical model does not account for variations in the extent of determinateness or indeterminateness among behavioral dimensions. Microfilm \$2.50; Xerox \$8.80. 191 pages.

ZOOLOGY

THE DYNAMICS OF DAPHNIA PULEX
POPULATIONS AND OF DUGESIA TIGRINA
POPULATIONS AS MODIFIED BY IMMIGRATION

(L. C. Card No. Mic 60-2506)

Joseph Thexton Armstrong, Jr., Ph.D.
University of Michigan, 1960

Although there have been numerous experimental studies of the effects of fishing on animal populations, there have been virtually no studies of the effects of the complementary stress, immigration. The present research was concerned with the effects of immigration upon 1) laboratory populations of the crustacean, Daphnia pulex, maintained by a constant supply of the alga, Chlamydomonas reinhardtii, and 2) laboratory populations of the flatworm, Dugesia tigrina, maintained by a constant supply of brine shrimp.

The average numerical size of a Daphnia population increased proportionally to the average number of newborn animals added per unit time, whether the newborn were added in constant or random numbers. An analysis of the

census data from all the Daphnia populations showed that the average caloric efficiencies of growth and reproduction of individual daphnids were 0.07 and 0.05 respectively. These efficiencies were found to be compatible with published information based on the study of individual daphnids. The efficiencies were also related algebraically to certain published Daphnia "population efficiencies" which involve the probability of death as a function of age. The author also estimated survivorship curves for the animals in the populations subjected to immigration. The absence of published data lends particular interest to prenatal survivorship; it varied from 58 to 72 percent.

In nature, Dugesia tigrina may reproduce predominantly by sexual means or exclusively by asexual means, depending on the locality. The animals used in this study reproduced only asexually, by binary fission. This consists in the shedding the posterior one-third of the body. The "tail" so produced differentiates into a feeding individual. At each census, a number of tails was added to an experimental population, in proportion to the number of tails produced in the population since the previous census.

The proportion was constant for a given population, but differed between populations.

The worms have an essentially unlimited life expectancy, and their populations are not regulated by natural mortality. Cannibalism, manifested principally as the consumption of tails by feeding individuals, served mainly to reduce the rate of increase of the populations. The rate constant, (number of tails eaten per two days/number of tails available · number of feeding individuals), averaged about 0.01. Reproduction or addition of tails or both caused populations to increase numerically. The consequent food shortage reduced average animal size, and gradually brought reproduction to a halt. Since tails were added to a population only when tails were produced in the population, the cessation of reproduction marked the beginning of a numerically static equilibrium. The size of the equilibrium population was roughly proportional to the number of tails added previously. At equilibrium a given dry mass of brine shrimp supported an equal dry mass of *Dugesia* from 0.10 to 0.35 days.

In addition to the population study, life tables were compiled for a clone of normal and a clone of particularly cannibalistic *D. tigrina*. Their average reproductive rates were, respectively, 0.24 and 0.10 tails per animal per two days. Microfilm \$2.50; Xerox \$5.20. 102 pages.

INHERITANCE OF RESISTANCE
TO LINDANE IN THE
GERMAN COCKROACH,
Blattella germanica (L.).

(L. C. Card No. Mic 58-7862)

John Grove Barker, Ph.D.
Virginia Polytechnic Institute, 1957

The World Health Organization defines insecticide resistance as "the development of the ability in a strain of insects to tolerate doses of toxicants which would prove lethal to the majority of individuals in a normal population of the same species." Although resistant insects have been encountered for some sixty years it has been only since World War II that they have caused widespread concern. It is apparent that the spread of resistance in this period is a direct result of the more rigorous selection brought about by use of the organic insecticides acting through inheritance mechanisms about which little is known. Thus there is a need for studies of the genetic mechanisms of insecticide resistance.

A population of German cockroaches resistant to lindane was developed by laboratory selection for eight years at the Virginia Polytechnic Institute. It was decided to determine whether this trait was due to autosomal or sex-linked genes; the relative frequencies of the genes for resistance, i.e. whether the character was dependent upon a single gene, or a complex of genes; and the length of time necessary for the resistant population to revert to the non-resistant condition in the absence of selection.

The cockroaches were reared under conditions of controlled temperature and humidity. Adults under 10 days in age were exposed to the insecticide by immersion in aqueous suspensions of the insecticide at selected concen-

trations. After four days mortalities were determined. The resulting data were plotted on log-probit paper in the form of regression lines by the method of least squares. Four to six points were used to establish each line; and for each concentration the tests were replicated from 3 to 6 times and involved from 100 to 200 insects.

Reciprocal crosses were made between the resistant and non-resistant strains of cockroaches. Controlled pair matings were made within the resistant and non-resistant strains. Backcrosses were made between reciprocal cross male progeny and females of the two parental strains. Further, a population of resistant cockroaches was reared in isolation from exposure to lindane for eight successive generations.

The following conclusions were drawn from this study.

1. That lindane resistance is not inherited as a simple sex-linked factor.
2. That it is not attributable to maternal effects, cytoplasmic factors, or to sex-linked epistatic genes.
3. That it is principally inherited through the autosomal chromosomes.
4. That lindane resistance is embodied in a multifactorial system of genes.
5. That the resistance is still in a heterogeneous condition although the variation in the resistant strain was not nearly so great as in the non-resistant strain.
6. That lindane resistance is relatively stable, there being a rather small loss of resistance through eight successive generations in absence of selection.

Microfilm \$2.50; Xerox \$4.40. 81 pages.

HORMONAL INVOLVEMENT IN THE
MOLTING PROCESS IN THE SOFT TICK,
ORNITHODOROS TURICATA DUGES.

(L. C. Card No. Mic 60-2633)

Beverley Lenore Cox, Ph.D.
The University of Oklahoma, 1960

Major Professor: Harriet Harvey

An attempt was made to determine whether or not there is hormonal involvement in the molting process of the soft tick, *Ornithodoros turicata* Dugès. The presence of an endocrine regulation of the molting process in this animal is suggested by the following facts: (a) there is a periodic shedding of the cast in its entirety rather than the occasional sloughing of individual groups of cells; (b) molting occurs at regular intervals; (c) molting never occurs without a blood meal except for the first molt which occurs shortly after hatching, and (d) molting does not occur unless the tick is sufficiently engorged.

Ticks were reared in a constant temperature chamber at 29° C. Under the laboratory conditions of this experiment data were collected on time sequences from feeding to molting in each of the five nymphal stages. The following techniques were then employed to determine the presence of an endocrine system; (a) morphological and histological

studies were made to determine the possible site of a hormone secretion. Ticks of the third instar were fixed in Bouin's solution before feeding and the remaining siblings were fed to satiety and a few of these engorged ticks were fixed on successive days through the period of molt. Similar studies were made on the adult ticks: Histochemical determinations were made; (b) third instar ticks were ligated just posterior to the brain (in back of the second pair of legs) in an effort to isolate the hormone either to the anterior or posterior end of the tick; (c) brain transplants were made from third instar ticks which had been fed 48 hours prior to the operation into adult ticks which had been fed 24 hours prior to the operation.

From the results of these studies it was concluded that the site of greatest histochemical change occurred in the ganglionic cells of the periphery of the brain of nymphal ticks which corresponded with physical molting. This same histochemical change did not occur in adult ticks. The employment of ligatures resulted in isolating the molting factor to the anterior end of the body. In no instance was the molting factor isolated to the posterior end of the body. The brain transplants resulted in a supernumerary molt of the adult.

Microfilm \$2.50; Xerox \$3.00. 52 pages.

THE BIOLOGY OF THE ORDER PHALANGIDA IN MICHIGAN

(L. C. Card No. Mic 60-2526)

Arlan Lee Edgar, Ph.D.
University of Michigan, 1960

It has been the purpose of the present investigation to contribute to our knowledge of the biology of the Phalangida of Michigan in the following areas: (1) composition and distribution in the state; (2) habitat characteristics and vegetation preferences of the constituent species; (3) nature of the associated populations of commonly-occurring species and certain aspects of their natural history; (4) life history of *Leiobunum longipes*, a species with widespread distribution but rather narrow habitat tolerances; (5) comparison of some of the physiological optima and tolerances of the species used in a population study; (6) correlation of inherent physiological qualities as determined in the laboratory compared with habitat selections as observed in the field.

The investigation was divided into three phases. The first phase involved a systematic collection of phalangids from all 83 counties of the state. Certain data concerning the natural environments of phalangids were taken simultaneously with these collections and used to construct what has been termed a vegetation profile. This profile utilizes both phalangid abundance and vegetation density in order to show habitat differences between species of phalangids. A key to the genera and species was composed. State distribution maps, by species, and locus keys for collection sites, by counties, were compiled. A total of nineteen species in eight genera were found to occur in Michigan. One new species, *Leiobunum lineatum*, was figured and described.

The study of a particular group of species constitutes the second phase. In this aspect of the investigation,

developmental and behavioral characteristics of four species, from the egg stage through mating to death, were pictured and described. Included were field and laboratory observations upon diurnal and seasonal migrations, the molting process, longevity, the mating procedure and oviposition phenomena.

The third phase was an outgrowth of the preceding two. To correlate habitat data obtained from the series of statewide collections with the natural history aspects of certain prevalent species, laboratory experiments were performed. The parameters of (1) temperature preferences, (2) relative humidity optima, and (3) survival in dry air were established in order to demonstrate, for the species studied, their relative abilities to effectively live in their observed habitats.

Several general conclusions concerning the habitats of Phalangids were drawn from the study. (1) Phalangids are found in almost any terrestrial situation which has shelter from sun and drying and a supply of water. (2) Some species are more able to inhabit successfully a wider range of habitats than others. (3) Phalangids found in a relatively exposed situations in nature preferred higher temperatures in a temperature gradient chamber, showed less sensitivity to relative humidity fluctuations, and lost body weight more slowly in a dry chamber than those that lived in more sheltered habitats.

Microfilm \$3.40; Xerox \$11.95. 261 pages.

THE AVIFAUNA OF SOUTHEASTERN COAHUILA, MEXICO.

(L. C. Card No. Mic 60-2634)

Charles Adelbert Ely, Ph.D.
The University of Oklahoma, 1960

Major Professor: George M. Sutton

An investigation carried out largely at elevations above 7500 feet in the vicinity of Saltillo and Las Vacas, in southeastern Coahuila, has made possible an analysis of the region's avifauna. Field work was done during the following periods: December 24, 1957 to January 1, 1958; June 13 to August 10 and September 19 to November 19, 1958; April 15 to June 13, 1959. The avifauna of the area is similar to that of montane parts of the southwestern United States.

The characteristic plant of the desert plateau (elevation 5000 to 6000 feet) is creosote bush. Slopes above the plateau are covered with pinon-juniper, scrub oak or chaparral, growth on the north slopes being much more mesic than that on the south slopes. On undisturbed north slopes forests of pine, oak and madrono thrive from 6000 to 8000 feet. At higher elevations the forest is almost exclusively coniferous.

Man's activities have profoundly affected the original vegetation. Some irrigated desert areas and the higher intermontane valleys are now widely cultivated. Extensive grasslands no longer exist. Where forests of oak, pine, and other conifers once stood, scrub oak and chaparral now grow. The conifer forests, restricted as they are today to the summits of the higher ridges, and surrounded as they usually are by desert, form "island" habitats. The

birdlife of these "islands" is depauperate indeed as compared with that of the extensive forests of the Sierra Madre Oriental.

Some breeding birds of the area studied are indicators of certain associate plant species, being found in only one habitat; some, though characteristic of one habitat, breed in several. In 1959, certain species nested on the desert plateau at 5000 feet approximately one month earlier than they did on the higher slopes near Las Vacas. At Las Vacas the larger hawks and owls started nesting in March, the smaller resident species in mid-April, and the summer residents in late April. Brown Towhees and gold-finches began nesting in late July at these higher elevations, the former continuing through August, the latter into October.

The earliest fall transients appeared July 22, but migration was heaviest between late August and early October, with a peak in September. Migration was slow and gradual, without sudden waves or peaks, in both spring and fall.

Most bird families of the area are widely believed to be of North American origin, but a few families of Old World and South American origin are about equally represented. The avifauna is composed of fewer species than that of similarly sized montane areas of the southwestern United States, but it includes a number of endemic Mexican species. The 207 forms known to inhabit the area represent 16 orders, 39 families, 129 genera, and 198 species.

Microfilm \$2.50; Xerox \$6.40. 134 pages.

THE RELATIONSHIPS OF THE ANOLES
(REPTILIA:SAURIA:IGUANIDAE):
AN INTERPRETATION BASED ON
SKELETAL MORPHOLOGY.

(L. C. Card No. Mic 60-2529)

Richard Emmett Etheridge, Ph.D.
University of Michigan, 1960

This study is concerned with variation in the skeletal morphology and other anatomical features of iguanid lizards. Its purpose is to determine the relationships of the genera and species of anoles to one another and to other members of the Iguanidae. By the application of soft (low voltage) x-ray photography to this problem, new information on the iguanid skeleton is obtained and taxonomic characters never before employed in saurian classification are revealed.

In the first part of the study, variation in the iguanid skeleton is described and the potential taxonomic value of certain skeletal characters is discussed. Systematic importance is indicated for: 1) arrangement of elements in the lower jaw, 2) relative size, structure and positional relationships of certain skull elements and the pineal foramen, 3) length of the second ceratobranchials, (4) number of presacral vertebrae and number of ribs in each region of the vertebral column, 5) presence or absence of zygosphenes, 6) structure and positional relationships of the elements of the pectoral girdle, sternum, xiphisternum and parasternum, and 7) presence or absence of caudal diapophyses and functional autotomy. Other anatomical features described and employed taxonomically are: 1) endolymphatic glands, 2) retinal foveae, 3) scale

sensory organs, 4) subdigital lamellae, and 5) nasal passage.

In the second part of the study the anole group and its component genera are characterized and the relationships of the group to other members of the family are discussed. *Diaphoranolis*, *Xiphocercus*, *Mariguana*, *Norops*, *Audantia* and *Deiroptyx* are not recognized as generic entities and the names are placed in the synonymy of *Anolis*. *Chamaeleolis*, *Chamaelinorops*, *Phenacosaurus* and *Tropidodactylus* are considered distinct from one another and from *Anolis* as well.

The third part of the study is concerned with the inter-relationships of the anoles. Inter- and intraspecific variation in 12 osteological features is described. The sequence of caudal vertebrae is used as the basis for separating the anole genera into two major lines, and for the separation of *Anolis* into two "Sections." The species of the Sections of *Anolis* are arranged into "Series," based on combinations of skeletal characters involving the splenial, the parasternum, the parietal, the pineal foramen and the pectoral girdle. Some speculations are offered as to the evolutionary relationships of the Sections and Series of *Anolis* and of the other anole genera.

The following conclusions are drawn from this study:

1. The anoles are separated from other iguanids by a wide morphological gap. They appear to be most closely related to *Polychrus* and *Aptycholaemus*.
2. There are two evolutionary lines in the anoles, one with primitive caudal vertebrae but an otherwise specialized skeleton, the other with specialized caudal vertebrae but an otherwise generally primitive skeleton.
3. The two sections arose on the mainland, one in northern South America and the other in Central America.
4. Two invasions are sufficient to account for the present distribution of anoles in the West Indies: 1) a very early member of the Section from northern South America, and 2) a somewhat later member of the Section from Central America.
5. The South American Section is presently represented in northern and western South America by primitive species and in the West Indies by groups of species showing various stages of skeletal specializations. The Central American Section is more uniform osteologically, though it contains far more species. It is presently represented in the West Indies by a few species and on the mainland, where it occupies the entire mainland range of *Anolis*, by a great many.

Microfilm \$3.25; Xerox \$11.25. 249 pages.

AN ANALYSIS OF SOME OF THE FACTORS
INFLUENCING THE LOCAL DISTRIBUTION OF
SMALL MAMMALS IN SOUTHERN MICHIGAN

(L. C. Card No. Mic 60-2533)

Lowell Lee Getz, Ph.D.
University of Michigan, 1960

A study was made of the factors influencing the local distribution of six species of small mammals (Sorex cinereus, Blarina brevicauda, Peromyscus leucopus, Microtus pennsylvanicus, Synaptomys cooperi, and Zapus hudsonius) in southern Michigan.

The problem consisted of three parts: (1) a generalized study of seven habitats (old field, hardwood swamp, coniferous swamp, bog mat, spruce burn, upland hardwoods, and marsh); (2) a more intensive investigation of the old field and marsh; and (3) a study along a series of transects.

The environmental factors considered were vegetation type, useful cover (fallen trees, brush, and leaf litter), temperature, food, moisture, and interspecific competition.

The type of vegetation exerted the most important influence upon the distribution of Microtus pennsylvanicus. This species fed almost exclusively upon graminoids and occurred in areas having such vegetation. It tended to avoid those grassy areas that also contained some woody plants. There was a correlation between the quantity of graminoid vegetation present and the population density of M. pennsylvanicus. This appeared to be a combined influence of a greater food supply and increased humidity resulting from the greater cover. Temperature differences in the various habitats exerted no major influence upon the local distribution of this species, although behavioral responses were noted. Moist areas were favored over dry areas or those with standing water. Interspecific competition was not important in the area of this study.

The local distribution of Blarina brevicauda was influenced primarily by moisture (substrate and/or air humidity). It was found only in moist situations, but avoided inundated areas. Cover was important only in its possible influence upon air humidity. It was scarce or absent in those habitats in which the available food supply (consisting of the larger forms of invertebrates) was low. Vegetation, type of cover, temperature, and interspecific competition were not important factors.

Sorex cinereus occurred in all habitats except the upland hardwoods. The reason for the avoidance of this habitat was not determined, but it was not a response to the type of vegetation. It was relatively less abundant in the drier situations than was B. brevicauda. It did not avoid standing water. S. cinereus is able to utilize smaller food items than is B. brevicauda so that its local distribution is not influenced by the availability of the larger invertebrates. Cover, temperature, and interspecific competition were not important factors in its local distribution.

Food was a major factor in the local distribution of Peromyscus leucopus. Its occurrence primarily in upland hardwoods most likely was attributed to a more stable food supply (mainly nuts and acorns). Temperature was not an important factor in the local distribution of this species. The amount of cover was important only with the habitats that were otherwise favorable. Interspecific competition was not an important factor in the area of this study.

Synaptomys cooperi occurred only in graminoid vegetation. It differed from M. pennsylvanicus in that it was

also abundant in areas that contained woody plants in addition to the graminoids. This species also appears less tolerant of dry conditions than M. pennsylvanicus. Temperature, cover, and interspecific competition were not important factors in its local distribution.

Zapus hudsonius was found only in moist situations and was slightly more abundant where there was standing water. Vegetation, temperature, cover, and interspecific competition were not important factors in its local distribution.

Microfilm \$2.55; Xerox \$8.80. 193 pages.

A FIELD STUDY OF ACTIVITY AMONG
SQUIRRELS (SCIURIDAE) IN
SOUTHERN MICHIGAN

(L. C. Card No. Mic 60-2536)

Evan Brandao Hazard, Ph.D.
University of Michigan, 1960

The purpose of this study was to investigate the role of social behavior in the ecology of sympatric species of squirrels under natural conditions. Seven species were studied for three years on the E. S. George Reserve in Livingston County.

The basic technique was visual observation of wild squirrels, some of which were trapped and marked for identification in the field and some, outside the Reserve, were collected for stomach analyses. Daily activity rhythms, and seasonal variations in these rhythms, were investigated by a series of observations made at one site during six alternate months. The aspects of solitary behavior observed were feeding, basking, grooming, and solitary play. The types of social behavior seen were sexual and parental care, contactual, allelomimetic (synchronous activity due to mutual stimulation), investigative, and agonistic (conflict). Agonistic behavior may be of importance in both intra- and interspecific social relations. From the standpoint of participation, encounters between animals were considered as unilateral when only one participant exhibited agonistic behavior, and as joint when both did.

The two most isolated species are the ground squirrel and the flying squirrel. The former is the only local species largely restricted to open fields; the latter, the only strictly nocturnal one. Interspecific social contact outside the nest is probably rare in both species. The woodchuck, an uncommon species, is somewhat isolated by its almost wholly terrestrial habits. Feeding primarily on herbaceous vegetation, it is not in competition for food with the other woodland forms, all of which have mast as a staple. The chipmunk is partially separated from the tree squirrels because it is more terrestrial and because its daily activity rhythm is somewhat different. Although there are some habitat differences among them, gray, fox, and red squirrels are not strongly isolated from one another.

Some generalizations can be made about several aspects of behavior of these squirrels. The species vary in the alertness exhibited while foraging. Some caching behavior patterns are innate. Grooming and drumming serve as displacement activities. In tree squirrels, mating chases are less important than some workers have suggested. The choruses of chipmunks, gray squirrels, and

red squirrels probably function in the maintenance of territories.

In unilateral encounters, which seem to occur as the result of chance meetings without regard to species, the smaller animal usually flees the larger. Of the diurnal tree squirrels, reds are most readily stimulated by intruders or strange objects, grays least so.

In contrast to unilateral encounters, joint encounters are most often intraspecific, indicating a specific orientation of aggressive patterns. The ritualization of intraspecific chases reduces physical combat. Dominance varies with sex and age, but no rigid peck-order was noted.

In interspecific joint encounters, certain species commonly dominated others. In such conflicts, dominance is a function neither of size nor of relative population density. Physical combat is again rare, though interspecific chases are less ritualized than intraspecific chases.

Social behavior patterns in squirrels have various beneficial effects with regard to predation, overcrowding, reproduction, and the reduction of physical combat. Under natural conditions, intraspecific conflict seldom seriously harms subordinate animals. Although certain species characteristically dominate others, interspecific conflict is probably not a major factor affecting populations of the species studied.

Microfilm \$3.80; Xerox \$13.30. 295 pages.

THE FOREST FLOOR AND ITS UTILIZATION BY SELECTED SPECIES OF TERRESTRIAL AMPHIBIANS

(L. C. Card No. Mic 60-2537)

Harold Franklin Heatwole, Ph.D.
University of Michigan, 1960

In this study I have analyzed the forest floor habitat to find the physical and microclimatic features important to amphibians, provided information on microhabitat selection, and indicated how different species have adjusted to this terrestrial environment.

The frogs, *Eleutherodactylus gollmeri* and *Eleutherodactylus maussi*, were studied in Venezuelan Cloud Forest, the frog, *Rana sylvatica*, in oak-hickory and swamp hardwood forests in southern Michigan, and the salamander, *Plethodon cinereus*, in beech-maple and oak-pine-aspen forests in northern Michigan.

Three main Classes of litter are recognized, each containing several types. Class I, Loose, is composed of rolled, curled, or bent leaves with large, round or angular interstices between them. Class II, Matted, has leaves lying flat on each other with small interstices between them; it tends to occur in shallower accumulations with less compressibility and a smaller volume of interstitial space. Class III, Dense, comprises large objects such as logs.

The Cloud Forest had a larger number of litter types, thinner F layer, and a greater percentage of bare soil and exposed F and H layers than the other forests studied. Where an H layer occurred, it was as thick as in temperate forests. In Cloud Forest and oak-pine-aspen forest, the litter was distributed in a mosaic pattern, but was rather uniform in the other forest types.

Herbaceous vegetation tended to prevent leaves from settling and caused a loosely structured litter. Depressions had thicker L, F, and H layers and root mats than level ground, whereas mounds had thinner ones.

The oak-pine-aspen forest had a moisture content two-thirds to three-fourths that of beech-maple and lost moisture faster following a rain. The stem-flow from rains of less than 0.4 in. did not affect the forest floor moisture 0.5 m. from a tree although at the base, moisture content was higher. The H layer and sand had about the same water-holding capacity, an amount which was approximately twice as great as that of the F layer and five times that of the L layer.

In dry periods in beech-maple forest, *P. cinereus* migrated downward to moister strata and laterally to refugia inside and beneath logs or to deep litter in depressions; after rains, when the litter became wetter than soil beneath logs, they moved in the reverse direction. They left a substrate when its moisture content reached the value at which they could no longer absorb water from it, approximately 0.12 ml. water per ml. substrate for both sand and humus. In the oak-pine-aspen area, local distribution was limited by lethal temperatures in some litter types.

Experiments showed that *P. cinereus* could not burrow in sand or enlarge holes already present. They burrowed in undisturbed humus with difficulty and then only when able to force themselves between a solid object and the substrate. However, they easily enlarged holes already present in humus by using their heads as wedges and pushing with legs and tail. Root mats provided partial barriers to burrowing.

P. cinereus responded to continued desiccation of experimental substrates by moving to more favorable sites, attempting to burrow, coiling, and finally wandering. All of these have survival value.

Local distribution of *R. sylvatica* in the non-breeding season was influenced chiefly by trees and ponds. The frogs occupied soggy, flat litter at the edges of pools, facing the water. When moisture conditions became unfavorable they moved under the cover of terrestrial litter. Also, a few large frogs were regularly found at moist sites away from ponds.

E. gollmeri remained in or on the litter diurnally but was found on low vegetation at night; it occupied the ecotone between mature forest and second-growth. *E. maussi* was strictly an inhabitant of the mature forest floor. Local distribution of *E. gollmeri* on the forest floor correlated with deep accumulations of I l, Bent, litter and plants 20-40 cm. tall.

E. gollmeri was less sedentary than *E. maussi* which occupied the same shelter in leaf litter as long as 16 days. Both species oviposited in the litter and the eggs were attended by a parent.

E. gollmeri desiccated to death in two-thirds to three-fourths the time required for *E. maussi*.

Microfilm \$5.45; Xerox \$19.15. 425 pages.

GROWTH AND DIFFERENTIATION IN CRASPEDACUSTA SOWERBII

(L. C. Card No. Mic 60-2549)

Andrew McClary, Ph.D.
University of Michigan, 1960

The asexual generation of the fresh-water coelenterate, *Craspedacusta sowerbii*, consists of colonies of polyps which may reproduce by forming polypoid, frustuloid or medusoid buds. The first bud type remains a part of the colony. The latter two types become detached as frustules or medusae. A study was made of the asexual generation with particular emphasis being placed on growth rates and morphological variation.

Colonies of *Craspedacusta* were grown from frustules collected in a tributary of the Huron River near Ann Arbor, Michigan. Colonies were maintained in finger bowls and petri dishes. Culture water was renewed with filtered water from the collection site. Polyps were fed brine shrimp nauplii.

The budding and growth pattern of a large number of polyps was studied. This pattern is described both in quantitative and qualitative terms. The effect of temperature was given particular attention. Temperatures above 33°C. or below 12°C. appeared to be outside the optimal range for colony growth and budding. Growth rates were markedly less and abnormality of medusoid buds increased above 33°C. and below 12°C. Growth at temperatures between 12°C. and 33°C. showed the following patterns.

(1) Initially, the bulk of growth occurred as an increase in colony size. Later in the experiment the bulk of growth occurred in the form of motile buds, either medusoid or frustuloid. This shift occurred earlier in the cases of cultures run at higher temperatures within the 12-33°C. range. (2) Over-all growth of the asexual stage, including both colony size increase and bud production, tended to reach a maximum and then drop off. This pattern of peak and subsequent decline was accelerated at higher temperatures within the 12-33°C. range. Frustuloid and polypoid buds were produced at all temperatures above 12°C. Medusoid buds were not produced below 27°C.

A second set of experiments involved the mutilation of polyps, frustules, medusae and developing buds. Polypoid and frustuloid tissue was found to have great potency. Cut pieces of polyps, frustules, polypoid buds or frustuloid buds typically formed first into resting bodies then into frustules which in turn developed into new polyps. Medusoid tissue in contrast, showed a high degree of determinative growth. In no case were cut pieces of advanced medusoid buds or freed medusae seen to reform into polypoid or frustuloid tissue.

The asexual stage of *Craspedacusta sowerbii*, as grown in the laboratory, shows marked variation with temperature, and it appears that such variation may be a characteristic of field populations. Mutilation experiments indicate that there is a qualitative difference between polypoid-frustuloid tissue and medusoid tissue, the former showing a much greater degree of potency.

Microfilm \$2.50; Xerox \$5.40. 108 pages.

MATING TYPE DETERMINATION IN VARIETY 8 TETRAHYMENA PYRIFORMIS

(L. C. Card No. Mic 60-2556)

Eduardo Orias, Ph.D.
University of Michigan, 1960

A cross-breeding analysis of wild strains of variety 8 of *Tetrahymena pyriformis* was carried out to investigate the mechanism of mating type determination in this species. Three strains collected at Alpena, Michigan, showing excellent viability of the progeny of their crosses and representing the three mating types known for the species, provided the source of natural variation used.

The majority of the results of crosses fit the following suggested hypothesis of mating type determination in variety 8. The three mating types appear to be respectively controlled by three different alleles of a single locus, designated as the *mt* (mating type) locus. Clones carrying at least one *mt^A* allele express mating type I. Clones carrying at least one *mt^B*, but no *mt^A*, alleles express mating type III. Clones carrying a double dose of the *mt^C* allele express mating type II. The six possible diploid combinations of these three alleles have been realized.

Two observations remain unaccounted for by the above hypothesis. Offspring of mating type II have appeared more frequently than expected in certain crosses, or in low frequencies (approximately 5%) in other crosses where none were expected. Secondly, selfers--clones within which mating takes place and cannot be assigned a mating type--have also appeared in low frequencies (less than 5%).

Every classical explanation for the appearance of unexpected type II clones which could be subjected to test has been excluded. The possibilities considered include self-fertilization, selfing, zygotic and gametic selection, and crossing over. It is suggested that these rare type II clones are the result of a relatively frequent mutation from *mt^A* to *mt^C*. This hypothesis finds circumstantial support in the observations made on selfers.

Two pure subclones of diverse mating types from one selfer were subjected to a series of progeny tests. It was found that the ratios of gametes produced by both subclones are highly aberrant but remain unchanged in crosses to clones of different genotypes and mating types. Hypotheses which could have explained aberrant ratios of the magnitude observed--postulating the presence of additional micronuclei, chromosome sets, or chromosome segments containing the *mt* locus--have been excluded. It is suggested that the aberrant ratios are due to an instability of the *mt* locus regularly resolved at the time of conjugation, or prior to it. Further investigation has shown that all the descendants of a pair are alike even in crosses involving the sublines from selfers where, presumably, instabilities are being resolved. Since the constancy of ratios excludes a cytoplasmic direction of stabilization, it is suggested that stabilization must occur at a time prior to the nuclear division which produces the migratory and stationary pronuclei to account for synclonal uniformity.

The findings are tentatively reconciled with each other by the following working hypothesis. Ordinarily, the alleles of the locus are stable and, consequently, inherited with great reliability in crosses. Infrequently, for unknown reasons, mutations take place from one stable allele to another stable one, or to an unstable, pluripotent allele. Prior to the time of reciprocal exchange of genetic material

potentialities of the unstable allele are reduced, and stable gametes in aberrant ratios are thus produced.

The resolution of an unstable, pluripotent condition of the *mt* locus in variety 8 appears analogous to the process normally taking place at the time of macronuclear development in variety 1 of *T. pyriformis*. In the case of variety 8, however, stabilization occurs prior to the separation of the new germplasm and soma. This property makes the process of stabilization directly accessible to the tools of classical genetics.

The high frequency and regularity of stabilization, particularly in selfers, suggest that the phenomenon falls into the category of mutations responsible for epigenetic differences. The similarities between the variety 8 findings and a selected series of recent observations in other organisms are discussed, as well as the possible role of epigenetic chromosomal alterations in cellular differentiation.

Microfilm \$2.50; Xerox \$4.40. 82 pages.

SCOTOPIC SENSITIVITY OF SNAKES OF THE FAMILY COLUBRIDAE, WITH A DISCUSSION OF THE ECOLOGICAL SIGNIFICANCE OF THEIR VISION.

(L. C. Card No. Mic 60-2566)

Archibald Wilson Sharer, Ph.D.
University of Michigan, 1960

This study has dealt with the pupillomotor sensitivity of snakes of the family Colubridae to low intensity monochromatic stimuli. The parallel between pupillomotor and retinal response indicates the utility of the former in gauging visual sensitivity. As histological findings have indicated the absence of rods in many round-pupilled Colubridae, information on the range of sensitivity of these snakes should be of value in interpreting their nocturnal behavior.

Experimental work was performed in a room illuminated only by a dim red light which served for adaptation of the snake and for observation of the pupil. The snake was mounted on a special retaining board in an area isolated by an opaque black hood. In front of the snake was a ground glass screen, upon which monochromatic light stimuli were projected from a calibrated lamp. The stimuli consisted of light flashes of 33 milliseconds duration produced at intervals of no less than two minutes. The quality of light was controlled by seven combinations of Wratten and Corning filters, and the intensity by an iris diaphragm and Wratten neutral filters. Testing consisted of exposing each snake to stimuli, which were varied in quality and in intensity, until a threshold for pupillary constriction was reached. Values so determined were rechecked a number of times and mean threshold values computed for each species at each wavelength.

Qualitative interspecific differences in the data may have been caused by experimental error in the techniques. The snakes showed a maximum sensitivity in the region 540-560 mμ. In the combined data of all species, the maximum sensitivity falls at about 550 mμ.

Interspecific quantitative differences occur with a range of about one log unit. In a study of six *Elaphe obsoleta quadrivittata*, intraspecific variability was moderate,

with a mean of 11.4 per cent for the coefficient of variation of the mean threshold at each spectral region.

Pupillomotor thresholds have been found at an illumination as low as .000011 foot-candle. Extensive observation of eight species permits a listing in approximate order of decreasing sensitivity: *Elaphe obsoleta spiloides*; *Lampropeltis getulus californiae*; *Natrix taxispilota*; *Pituophis d. deppei*; *Natrix sipedon pictiventris*; *Thamnophis sauritus proximus*; *Thamnophis s. sirtalis*; *Natrix erythrogaster transversa*. Less complete data have been obtained for twelve other species.

The pupillomotor sensitivity curves are in reasonably good agreement with curves of other vertebrates considered to represent cone activity. This confirms the histological data and suggests strongly that the pupillomotor photoreceptors of these snakes are cones.

In prey detection and capture, vision is of major importance, second, perhaps, only to olfaction. These experiments indicate that the pure cone colubrid eye can function under illumination comparable to that at night from natural sources. Field observations and limnological data suggest that this includes perception of distant objects and of objects beneath water.

In at least one species, aggregation is essentially dependent upon visual cues, and it appears likely that vision is similarly employed by other species.

Experimental studies and field observations emphasize the importance of olfaction in reproductive activities. The low incidence of sexual dimorphism in snakes implies that vision is of little importance in sex recognition. Some observations suggest, however, that vision is functional in sex recognition as well as in other aspects of reproductive behavior.

Detection and recognition of predators also appears to rest chiefly on olfactory cues, although the behavior of some snakes implies that at least the initial detection is visual.

Microfilm \$2.50; Xerox \$5.80. 119 pages.

THE BIRDS OF FINCA "LA SELVA," COSTA RICA: A TROPICAL WET FOREST LOCALITY.

(L. C. Card No. Mic 60-2569)

Paul Bentley Slud, Ph.D.
University of Michigan, 1960

This is a study of the bird life of one square mile in an area of Tropical Wet Forest (as defined by the Holdridge classification of the world's vegetation) in the northeastern Caribbean lowlands of Costa Rica. An entire year, lasting from September, 1957, to September, 1958, was spent at Finca "La Selva," located at approximately 10°30' N and 84° W, at the junction of the rivers Puerto Viejo and Sarapiquí, in the province of Heredia. The region is almost entirely virgin-forested, and the vegetation is probably the most luxuriant in all of Central America. The project was conceived with two purposes in mind. The first was to obtain a complete check-list of the birds, with annotations for each species in regard to its status as a resident or visitant, abundance, habitat and habits, sociability, and the like;

and to elaborate ecological arrangements among which the entire avifauna could be apportioned, regardless of the birds' taxonomic relationships. The second purpose was to relate "La Selva" ecologically to Costa Rica, to Central America, and to the world, and to attempt to draw conclusions of perhaps universal application to tropical birds in general.

The materials and methods were simple. The materials consisted of an 8-power binocular and a notebook and pencil; the methods, of patrolling the square mile (soon reduced to a square kilometer) for many hours daily, visiting the various habitats, and taking notes. Two-week surveys were conducted periodically in order to discover fluctuations in abundance and to determine which species were seasonal in occurrence.

The dissertation is divided into six sections. The Introduction, after stating the scope of the study and the methods, outlines the sorts of variations in status during the year which characterize both the native, neotropical avifauna and the migrants. The section entitled Environment gives pertinent information on the physical and botanical environment at Finca "La Selva": the location, the physiography, the climate, and the vegetation. There is a discussion of terms, such as "tropical," "rain forest," and the like, followed by a verbal sketch of the nature of the "La Selva" forest. The section Habitats and Habits is concerned with terminology and broadly classifies the environment and the places of occurrence and habits of the birds. Next follows an ecologically Annotated List of the 331 species recorded for the study area, with a terse, ecological summary for each family of birds. The fifth section, Ecological Classification, arranges the birds into major and minor categories that cut across taxonomic lines. Lastly, the section Discussion and Conclusions compares "La Selva" with other localities, discusses the meaning of "neotropical," and pays particular attention to the suboscines as a characteristic element in the tropical American avifauna.

Several conclusions can be drawn directly or indirectly from the study. It is shown that the Neotropical Region is a valid zoogeographical division for present-day birds, whereas the neotropics, as an ecological concept, is an elastic term applicable to present, past, and future distributions of faunas under tropical conditions. The neotropical avifauna, therefore, must include the birds in Central America as well as those in South America. The neotropical avifauna, as opposed to tropical birds in the Old World, is characterized by a taxonomic group: the Suborder Tyranni, with about 1100 species. With respect to wintering migrants as an element in the Central American avifauna, it is suggested that they complement the native birds ecologically rather than compete for food and living space. Also, it is postulated that migration routes may have become established through a process of natural selection. Finally, it is suggested that the avifauna at wet-forested "La Selva" provides a basis for ecological comparison with the avifauna in similar localities in the Old World.

Microfilm \$3.60; Xerox \$12.60. 280 pages.

A STUDY OF THE PLACENTA OF THE WHITE MOUSE BY HISTOLOGICAL AND HISTOCHEMICAL MEANS

(L. C. Card No. Mic 60-2588)

Pauline Jane Wood, Ph.D.
University of Michigan, 1960

The purpose of this study was to describe the placenta of the white mouse, using a variety of histological and histochemical techniques, and giving particular attention to the presence of glycogen, alkaline phosphatase, esterase, and di-phosphopyridine nucleotide diaphorase.

As a means of characterizing the usual developmental pattern of the mouse placenta, a series of histological sections were prepared on pregnant uteri at each of the days five through eighteen of the gestation period. Major developmental features revealed by these sections included: implantation antimesometrially with subsequent swelling of decidual tissues and occlusion of the uterine lumen; invasion of maternal tissues by the ectoplacental cone mesometrially and by the giant cells laterally and anti-mesometrially, accompanied by rapid enlargement of the embryonic vesicle; fusion of the chorion with invasive trophoblast at the mesometrial pole of the blastocyst; formation and growth of allantoic vessels into the chorion and trophoblast concomitant with vascularization of the visceral wall of the yolk sac; and finally the completion of the hemochorial placenta and exposure of the yolk sac to the uterine lumen.

Glycogen was detected by use of the periodic acid-Schiff reagent on sections cut from uterifixed in Gendre's fluid and embedded in paraffin. Pattern of the reaction using this method suggested stores of glycogen in the decidua basalis during early developmental stages. In middle and later gestation glycogen remained in the decidua basalis, but appeared also in fetal cells of the trophoblast at the junctional zone between maternal and fetal placental elements.

Test for the presence of alkaline phosphatase was carried out using the diazo coupling reaction of Pearse. By this means it was found that an intense reaction occurred in the primary and secondary decidua of the uterus at eight and nine days' gestation. When the fetal placenta becomes established at eleven to twelve days, alkaline phosphatase is concentrated in labyrinthine trophoblast.

The azo dye method was used also for determining the presence of esterase. This enzyme occurred most prominently in fetal trophoblast of the junctional zone from about the eleventh day through the eighteenth, which was the last day studied.

Using the method of Farber, Sternberg, and Dunlap, localization of DPN diaphorase was determined. In the mature placenta this enzyme is localized across the junctional zone in both fetal and maternal elements.

While DPN diaphorase serves to indicate oxidative metabolic activity, the localization of alkaline phosphatase and esterase suggest their function in transport of metabolic substances across the placental barrier.

Microfilm \$2.50; Xerox \$4.00. 71 pages.

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SUMMARIES OF MUSICAL PERFORMANCES

SUMMARY OF PERFORMANCE MATERIALS (Tape Recording Available at the University of Michigan School of Music Library)

Harry Walter Dunscombe, A.Mus.D.
University of Michigan, 1960

In partial fulfillment of the requirements for the degree
Doctor of Musical Arts, the following works were offered
in public performance:

I. March 19, 1959, with Sherman van Solkema, pianist

Ross Lee Finney, Sonata No. 2 in C major
for violoncello and piano
Johann Sebastian Bach, Suite No. 4 in E-flat
major for unaccompanied violoncello
Antonin Dvořák, Concerto in B minor, Op. 104,
for violoncello and orchestra

II. April 5, 1959, with Theodore Johnson, violinist, and
the Plymouth Symphony Orchestra, Wayne
Dunlap, conductor

Johannes Brahms, Concerto in A minor, Op. 102,
for violin, violoncello, and orchestra

III. May 25, 1959, with Sherman van Solkema, pianist

Ludwig van Beethoven, Sonata in F major, Op. 5,
No. 1, for piano and violoncello
Zoltán Kodály, Sonata, Op. 8,
for unaccompanied violoncello
Pietro Locatelli, Sonata in D major,
for violoncello and basso continuo

The works selected represent the more virtuoso side
of the violoncello repertory. In order to present a wide
variety of musical forms and periods, the programs in-
cluded concerted sonatas for violoncello and piano, works
for solo violoncello, and a concerto with orchestra. The
music of each genre was chosen from the historical period
or periods in which it was most prolifically or significantly
cultivated, and nearly the whole history of violoncello
music is represented.

Of the two sonatas for violoncello and piano, Beetho-
ven's, the first of his five, shows his preoccupation with
problems of formal design and the relationship of the two
instruments. The Sonata by Ross Lee Finney presents
the paradoxical character of the twentieth century--meticu-
lous order combined with elegiac lyricism, now rigidly
binding the player, now requiring of him the utmost freedom.

The Sonata by Locatelli is composed of movements
from two sonatas originally for a solo violin and basso
continuo. Although a transcription, the work has become
an established part of the violoncello repertory. Trans-
posed to the lower octave, the Sonata requires greater
virtuosity on the violoncello than on the violin, and the
slow movement takes on a more serious mood.

The Concerto by Dvořák is perhaps the best-known of
the nineteenth-century compositions for violoncello and
orchestra. It manifests the lyricism, relative looseness
of form, and variety of musical ideas typical of its period.

Brahms' Double Concerto, performed with orchestra,
offered a two-fold problem of balance--that of comple-
menting the solo violin, and that of competing in terms of
sonority with the powerful orchestra. The work, like all
of Brahms' solo concertos, is basically symphonic.

The two unaccompanied works, one each from the
eighteenth and twentieth centuries, are paragons of their
type--the nineteenth century produced little of merit in
this medium. Bach's Suite is so profound in form and con-
tent that it becomes a strong challenge to the performer's
integrity as interpreter, and its tonality and frequently
chordal style create serious problems of intonation.
Zoltán Kodály's Sonata explores the boundaries of con-
temporary instrumental technique, and represents an ulti-
mate in sheer virtuosity.

Foremost among the values derived from the study of
these works was a greater capacity for understanding and
presentation of widely divergent types and periods of
music. Also exceedingly valuable was the insight gained
into the technical problems of works extremely demanding
in instrumental terms.

SUMMARY OF PERFORMANCE MATERIALS (Tape Recording Available at the University of Michigan School of Music Library)

Charles Raymond Fisher, A.Mus.D.
University of Michigan, 1960

Program I

J. S. Bach Partita No. 1 in B-flat
Beethoven Sonata in A-flat, Op. 110
Schumann Davidsbundler, Op. 6

Program II

Beethoven Variations, Op. 34
Mozart Sonata in D, K. 311
Prokofieff Sonata No. 3
Hindemith Sonata No. 2
Debussy La serenade interrompue
La puerto del Vino
Feux d'artifice
Chopin Ballade No. 3 in A-flat

The above programs, presented in partial fulfillment
of the requirements for a Doctor of Musical Arts in Per-
formance, are stylistically and formally representative of

keyboard literature. Each includes contrasting forms and various periods while grouping compatible styles and tonalities into an artistic whole.

In the first Partita of J. S. Bach, the corrente in quick triple meter replaces the moderate, more refined courante with its characteristic hemiola, and the non-fugal giga replaces the gigue. The national origin of these dances justifies the name Partita and shows the Italian influence which was being felt throughout Northern Europe.

Mozart considered the D major Sonata, K. 311, to be one of his best and most difficult works for solo piano. In the opening movement, Mozart's juxtaposition of thematic material is evident in the absence of the principal theme in the recapitulation, and its unexpected appearance at the beginning of the coda. The aria-like second movement, exemplifying Mozart's affinity for "vocal" lyricism, is followed by a brilliant movement in rondo-sonata form.

Many of Beethoven's innovations in the piano sonata are found in Opus 110: the freedom of key relationships in the first movement; the inclusion of a scherzo; the use of an alternating arioso and fugue for the final movement, which is preceded by a dramatic recitative-like introduction containing the unusual "bebung." While its textures vary greatly within and among movements, it remains a forceful and unified musical whole typical of the originality and craftsmanship of Beethoven's last years.

The unique key relationships of the Variations, Op. 34 set it apart from other compositions in this form. The theme, in F major, is succeeded by five variations whose tonalities descend in minor and major thirds (D, B-flat, G, E-flat, C minor). The final variation returns to F major, followed by a highly ornamented version of the original theme. In this work Beethoven has already forsaken the purely ornamental variations of the classical style for the character type which is to dominate in the era to follow.

The large romantic keyboard work, consisting of many bipartite and tripartite pieces, is unique with Schumann. The Dauidsundler represents the Romantic spirit in its subjective nature, its full use of the piano's expressive potentialities, and its literary reference.

The term Ballade, as applied to the keyboard character piece popularized by Chopin, stems from the early heroic vocal ballad. The title becomes meaningful with the knowledge that the four Ballades were inspired by the poetry of a fellow Pole, Adam Mickiewicz.

Impressionism, though pianistically effective as demonstrated in the preludes, was soon exhausted and replaced by more versatile idioms. Impressionistic devices were carried over into other styles, but, for the most part, the movement died with its chief exponent, Claude Debussy.

Of the many twentieth century trends, two are represented in the contemporary works. The Hindemith Sonata, a crystalline, compact work in three movements, is neo-classic; the Prokofieff, while employing similar harmonic and contrapuntal devices, exemplifies the post-romantic in its rich texture and rhapsodic one movement organization.

Supplementary work included lecture recitals on the music of Bach, Mozart, Beethoven, Chopin, Faure, Debussy and Prokofieff as well as a performance of Mozart's Concerto, K 491 with the Jackson Symphony orchestra.

SUMMARY OF PERFORMANCE MATERIALS (Tape Recording Available at the University of Michigan School of Music Library)

C. Nolan Huizenga, A.Mus.D.
University of Michigan, 1960

Two recitals were presented in partial fulfillment of the requirements for the degree of Doctor of Musical Arts in performance:

I	II
Haydn, Sonata in E-flat major, (Hoboken, XVI, No. 52)	Schubert, Sonata in B-flat major, (Deutsch, No. 960)
Bach, French Suite in G major	Debussy, Les sons et les parfums
Beethoven, Sonata in E major, Op. 109	La soirée dans Grenade
Chopin, Sonata in B minor, Op. 58	Reflets dans l'eau
	Prokofiev, Sonata No. 7, Op. 83

Individual works were chosen for their musical quality and importance in the piano repertory. Their arrangement within the two recitals was based on the principles of balance and contrast.

Taken together, the compositions constituted a historical survey of keyboard styles from the baroque era to the twentieth century. Individually, they represented the creative output of seven major composers from Bach to Debussy and Prokofiev. Bach was represented by one of the rather early and concise French Suites. Debussy's program pieces were taken from different collections. The five major works played were sonatas, each dating from the last period of the composer and representing his mature piano style.

Haydn's Sonata is an extensive three-movement work in classical design. Main materials are characterized by melodic terseness and rhythmic vitality. The outer movements are separated by a highly ornamented aria in the unexpected key of E major. The texture of the last movement, with its clear part-writing and hints of imitative technique, suggests the style of a Haydn string quartet.

Beethoven's Sonata is a poetic work revealing both classical and romantic traits. The first two movements are characterized by extreme economy of materials and compact design. The opening movement is in sonata form stripped of transitional and subsidiary elements. Within this strict formal limitation, Beethoven achieves dramatic contrast of materials. In the exposition, a short opening theme leads directly through a pivotal diminished seventh chord to a brief subject of contrasting rhapsodic character. A succinct development follows with sequential treatment of the first material. The middle movement is a tightly-knit scherzo in sonata design, generated entirely by two rhythmic subjects appearing simultaneously in the first four measures. A chorale-like theme with six character variations constitutes the expansive final movement. In the first variation, Beethoven anticipates elements of Chopin's pianistic style.

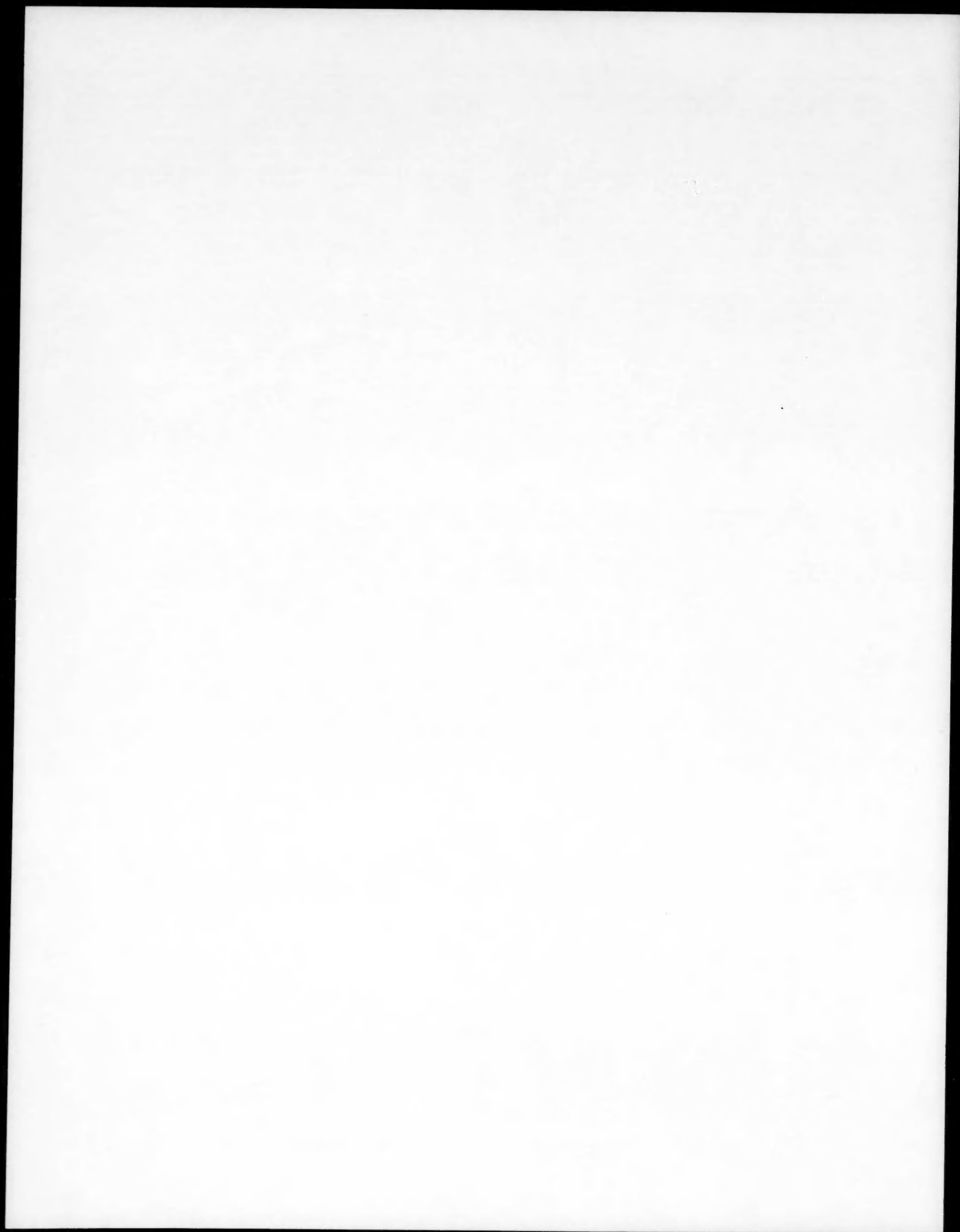
Schubert's Sonata, like that of Beethoven, is primarily lyrical in character. Unlike Beethoven's Sonata, it assumes broad dimensions based upon numerous materials and sectional developments. Most sections and main materials within sections are linked tonally by keys in

relationship of thirds. Pedalpoints in every movement emphasize the broad tonal outlines within and between sections. The irresistible charm of the Sonata lies in its song-like themes and subtle harmonic and modulatory changes.

Chopin's Sonata is a large-scale romantic composition in four movements. The first movement offers a rich variety of pianistic materials within a loose sonata-allegro form. It achieves meaning as a sonata design largely through the use of traditional key relationships between main materials. A scherzo, customarily the third movement, occurs second in this work. It is followed by a slow aria movement. The finale is a fast-moving rondo in which Chopin fully exploits the technical resources of the piano.

Prokofiev's Sonata illustrates the contemporary predilection for percussive exploitation of the piano. Composed during World War II, it seemingly reflects the turbulence of the war years. The first movement, on the tonal level of B-flat, combines angular themes and dissonant harmonies. It is followed by an intensely chromatic minuet on the tonal level of E. A stunning finale, in 7/8 meter and titled Precipitato, drives the sonata to a brilliant conclusion on a persistent rhythmic ostinato.

The two recitals were complemented by a performance of Mozart's Concerto in C minor, K-491 with the Houghton College Symphony Orchestra. Additional work included illustrated lectures and lecture recitals on solo and chamber music by Mozart, Beethoven, Brahms, Debussy, Bartók, and Prokofiev.



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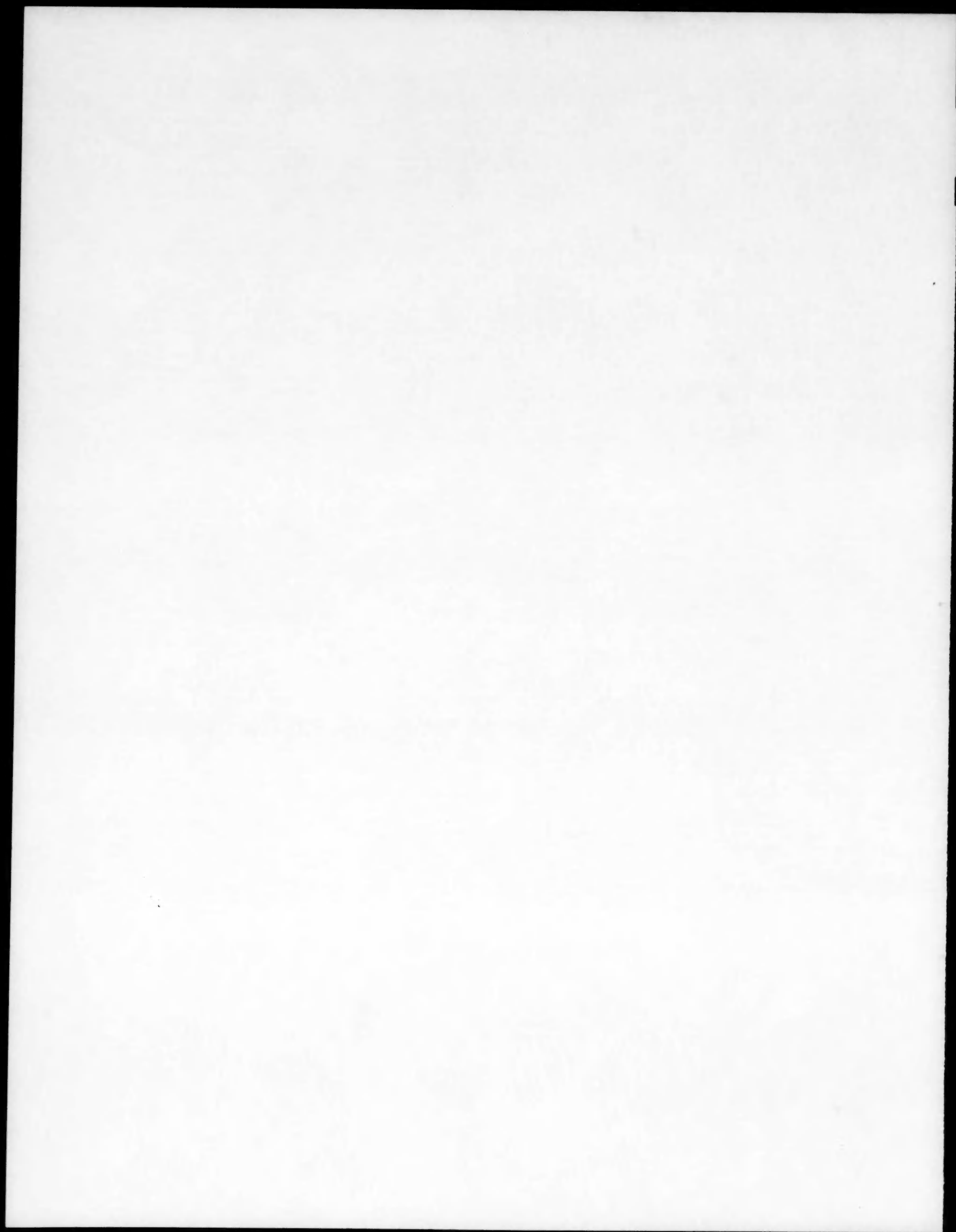
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